

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. <b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b>					
1. REPORT DATE (DD-MM-YYYY) 05-04-2007		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) 21-07-2006 to 5-04-2007	
4. TITLE AND SUBTITLE An Analytical Approach to Prioritizing the Development of Seabasing Components				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Michael D. Luckett, LCDR, USN				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Joint Forces Staff College Joint Advanced Warfighting School 7800 Hampton Blvd Norfolk, VA 23511-1702				8. PERFORMING ORGANIZATION REPORT NUMBER JFSC 25789	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT A fully-developed Seabasing capability would be of substantial value to the Joint Force commander, enhancing the Joint Force's freedom of action and significantly improving its agility in support of national military and strategic objectives. It would reduce the time from decision to action by eliminating the need to build supplies ashore before starting operations, enable the Joint Force to act without the political constraints of friendly host nation access, and defer the time until the Joint Force commander must have a large supply base ashore to continue operations. The two main challenges to the full implementation of Seabasing are that the equipment required is expensive and that several critical pieces of technology required do not yet exist. Because of this, an incremental approach to developing and fielding Seabasing technologies is the most fiscally and strategically responsible plan. This study helps to enlighten the choices required for this incremental approach by demonstrating a method to analytically compare various building block technologies. Potential solutions in four key capability areas are analyzed for their relative value to Seabasing, value to the Joint Force in other areas, procurement cost, and technological development status. The results of this analysis are reviewed to provide prioritized recommendations on how to efficiently allocate scarce budgetary resources towards the various programs that are needed to fully realize the Seabasing concept.					
15. SUBJECT TERMS Seabasing, Transformation					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Unclassified Unlimited	18. NUMBER OF PAGES 138	19a. NAME OF RESPONSIBLE PERSON SPC Dirk Rasmussen, USA
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED			19b. TELEPHONE NUMBER (include area code) 757-463-6301

**JOINT FORCES STAFF COLLEGE  
JOINT ADVANCED WARFIGHTING SCHOOL**

**AN ANALYTICAL APPROACH TO PRIORITIZING  
THE DEVELOPMENT OF SEABASING COMPONENTS**

by

**Michael D. Lockett**

**LCDR, USN**

**A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy.**

**The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.**

**Signature: \_\_\_\_\_**

**5 April 2007**

**Thesis Adviser: CAPT Shannon Hurley, USN**

THIS PAGE INTENTIONALLY LEFT BLANK

## **Abstract**

A fully-developed Seabasing capability would be of substantial value to the Joint Force commander, enhancing the Joint Force's freedom of action and significantly improving its agility in support of national military and strategic objectives. It would reduce the time from decision to action by eliminating the need to build supplies ashore before starting operations, enable the Joint Force to act without the political constraints of friendly host nation access, and defer the time until the Joint Force commander must have a large supply base ashore to continue operations. The two main challenges to the full implementation of Seabasing are that the equipment required is expensive and that several critical pieces of technology required do not yet exist. Because of this, an incremental approach to developing and fielding Seabasing technologies is the most fiscally and strategically responsible plan.

This study helps to enlighten the choices required for this incremental approach by demonstrating a method to analytically compare various building block technologies. Potential solutions in four key capability areas are analyzed for their relative value to Seabasing, value to the Joint Force in other areas, procurement cost, and technological development status. The results of this analysis are reviewed to provide prioritized recommendations on how to efficiently allocate scarce budgetary resources towards the various programs that are needed to fully realize the Seabasing concept.

THIS PAGE INTENTIONALLY LEFT BLANK

## Table of Contents

<b>Introduction – What is Seabasing? .....</b>	<b>3</b>
Tracing the Strategic Lineage of Seabasing.....	6
Seabasing – A Historical Perspective .....	11
<b>Methodology for Analyzing Alternatives to Satisfy Key Capabilities .....</b>	<b>23</b>
Seabasing Utility .....	23
<i>Seabasing Utility Metrics for Staging Platforms .....</i>	<i>23</i>
<i>Seabasing Utility Metrics for Aircraft Connectors .....</i>	<i>25</i>
<i>Seabasing Utility Metrics for Surface Connectors .....</i>	<i>26</i>
<i>Seabasing Utility Metrics for At-Sea Bulk Cargo Transfer .....</i>	<i>27</i>
<i>Seabasing Utility Metrics for Logistics Support Technologies.....</i>	<i>28</i>
Joint Force Utility .....	28
Developmental Status .....	29
Cost to Field.....	30
<b>Evaluation of Potential Solutions to Key Capabilities.....</b>	<b>31</b>
Key Capability Area #1 – Staging Platforms.....	31
<i>Tarawa-class (LHA 1).....</i>	<i>31</i>
<i>Wasp-class (LHD 1).....</i>	<i>34</i>
<i>LHA(R).....</i>	<i>36</i>
<i>Austin-class (LPD 4).....</i>	<i>38</i>
<i>San Antonio-class (LPD 17) .....</i>	<i>40</i>
<i>Whidbey Island-class (LSD 41) .....</i>	<i>42</i>
<i>Harpers Ferry-class (LSD 49).....</i>	<i>44</i>
<i>MLP.....</i>	<i>46</i>
<i>T-AKR LMSRs.....</i>	<i>49</i>
<i>T-AKE .....</i>	<i>51</i>
<i>Legacy T-AK .....</i>	<i>53</i>
<i>MPF 2010 .....</i>	<i>55</i>
<i>Sea Force .....</i>	<i>58</i>
<i>Maersk S-Class Conversion.....</i>	<i>60</i>
Key Capability Area #2 – Aircraft Connectors.....	64
<i>CH-46.....</i>	<i>64</i>
<i>CH-53E.....</i>	<i>66</i>
<i>MV-22 .....</i>	<i>68</i>
<i>CH-53K.....</i>	<i>70</i>
<i>Sikorsky X2HSL .....</i>	<i>72</i>
<i>V-44 Quad Tilt-Rotor.....</i>	<i>74</i>
Key Capability Area #3 – Surface Connectors .....	76
<i>LCAC.....</i>	<i>77</i>
<i>LCU-1600 .....</i>	<i>79</i>
<i>Joint Maritime Assault Connector.....</i>	<i>80</i>
<i>LCU-X.....</i>	<i>82</i>
<i>LCTAC .....</i>	<i>83</i>
<i>Zubr.....</i>	<i>86</i>
<i>Joint High Speed Vessel.....</i>	<i>88</i>

<i>Pelican WiG</i> .....	91
<i>Walrus</i> .....	95
Key Capability Area #4 – At-Sea Bulk Cargo Transfer .....	97
<i>Transfer to Internal Lighters</i> .....	97
<i>Transfer to External Lighters</i> .....	100
<i>Direct Ship-to-Ship Transfer</i> .....	103
Key Capability Area #5 – Logistics Support Technologies.....	105
<i>Joint Modular Intermodal Distribution System</i> .....	106
<i>Shipboard Automated Warehousing</i> .....	109
<b>Analysis, Conclusions, and Recommendations for Further Study</b> .....	<b>111</b>
<b>Appendix 1 – Detailed Analysis Results</b> .....	<b>119</b>
<b>Appendix 2 – Calculation of Number of Aircraft Connectors Required</b> .....	<b>123</b>
<b>Bibliography</b> .....	<b>125</b>
<b>Vita</b> .....	<b>133</b>

## Introduction – What is Seabasing?

The doctrinal foundations of Seabasing are contained in two major documents.

The *Seabasing Joint Integrating Concept (JIC) Version 1.0* (August 2005) is the definitive JCS-approved publication that outlines the concept of Seabasing, how it is to be accomplished, and how it integrates with other joint force operations. From this document:

Seabasing is defined as the rapid deployment, assembly, command, projection, reconstitution, and re-employment of joint combat power from the sea, while providing continuous support, sustainment, and force protection to select expeditionary joint forces without reliance on land bases within the Joint Operations Area (JOA). These capabilities expand operational maneuver options, and facilitate assured access and entry from the sea.<sup>1</sup>

The Seabasing JIC is supported by the operational and tactical level guidance contained in Naval Warfare Publication (NWP) 3-62M / Marine Corps Warfare Publication (MCWP) 3-31.7 *SEABASING*. In this document, Seabasing is defined as an integration of some elements of sea control, assured access, and power projection (long-standing traditional naval missions) with more of an emphasis on expeditionary maneuver warfare.<sup>2</sup>

Seabasing opens up new options for the Joint Force commander by delaying (for large scale operations) or eliminating entirely (for small scale operations) the need to build an “iron mountain” of materials at a host nation facility. This reduces the required lead time between the decision to conduct an operation and its commencement and also

---

<sup>1</sup> U.S. Department of Defense, Office of the Joint Chiefs of Staff, *Seabasing Joint Integrating Concept: Version 1.0* (Washington D.C., 2005), 5.

<sup>2</sup> U.S. Department of Defense, Navy Warfare Development Command and Marine Corps Combat Development Command, *NWP 3-62M/MCWP 3-31.7 (AUGUST 2006), SEABASING* (Newport, RI, 2006), p. 1-3.



allows for limited scale operations without requiring the US to obtain host nation access first.

So, what is new here? At first glance, not very much. The basic concept of Seabasing is not very different from what navies and naval infantry have been doing for centuries. The idea and practice of assembling, deploying, and supporting land forces from ships at sea is not new. Long range operations conducted with ship-based support were very common in the Pacific theater of operations in World War II. More recently, the UK's campaign to retake the Falkland Islands from Argentina in 1982, *Operation Corporate*, is another example of this type of operation. However, some fundamental differences between these historical operations and the new Seabasing concept extend prior doctrine and practices. The first difference is the ability to close and assemble the forces while at sea from ship-loaded equipment and deployed troops, as opposed to doing so in a friendly port. The second difference is the ability to indefinitely sustain large ground forces while they are operating far from the supporting ships. Supplies are to be shipped from rear areas to the sea base and then transshipped to combat forces ashore without having to secure a port facility or build up stockpiles on land. A third difference is the ability to reconstitute the deployed land forces on the ships of the sea base for future deployment in another area of operation. Thus, Seabasing is an evolutionary extension of a proven concept, with significant new capabilities; it is not a new and revolutionary idea.

What makes Seabasing such a challenging concept to bring to fruition is the scale, both in numbers of troops and distances, that is proposed. The problem is that to execute this concept, on a global stage, with the force levels being considered, will require a

significant expenditure in new ships (big-deck, high speed, containerized amphibious aircraft carriers) and aircraft (large, long range, naval airlift). A lot of money and energy will have to be invested in a concept that is unproven on this scale. This is not to say that the Seabasing concept is not a capability that the US military should pursue. On the contrary, several key Seabasing building block capabilities could be developed and exploited that have more universal application. Some examples of this are common containerized transportation systems, on-demand warehousing systems, high-sea-state cargo transfer systems, and high speed sealift. Each of these pieces has intrinsic value both in and out of the Seabasing concept.

An incremental approach to developing and fielding Seabasing technologies is the most fiscally and strategically responsible plan. This incremental approach needs to start by identifying which building block technologies are the most useful and feasible, both for Seabasing as well as in the Joint environment, and focusing development energies there first. In parallel, the US military needs to be fielding and operationally testing as much of the Seabasing concept as can be done now, integrating each of the new building blocks as they become available.

How should the US military leadership intelligently determine how and where scarce defense research and procurement funds should be invested in support of the Seabasing concept? This study will attempt to answer that question with a qualitative analysis technique. This method will begin by examining the Seabasing concept in order to determine what key capabilities are required to execute the concept. Proposed solutions to fulfill each of these key capabilities will be examined in order to determine their utility to the Seabasing concept, their utility in other Joint applications, their relative

cost to field, and their current state of development. Based on these evaluations, a prioritized list of recommendations will be developed with the goal of maximizing the likely gain in value for the Joint Force while minimizing cost and technical risk.

### Tracing the Strategic Lineage of Seabasing

In order to set the stage for this analysis, a brief review of the strategic and historical context of Seabasing is in order. The Seabasing concept is nested in concepts that are outlined in the various national strategic guidance documents. This section traces that nesting through each level of strategic documents, from highest to lowest, starting with the 2006 National Security Strategy (NSS).

At first glance, it would appear that Seabasing is nested in Chapter IX of the NSS (*Transform America's National Security Institutions to Meet the Challenges and Opportunities of the 21st Century*), as this is the primary strategic guidance directing all force transformation, including Seabasing. Two categories of challenges listed in this chapter—traditional and irregular—are addressed by Seabasing.<sup>3</sup> Both traditional and irregular challenges typically require the employment of military forces at some distance away from the United States. Thus, Seabasing may be a component of force projection and sustainment for these types of challenges. For traditional challenges, this is projecting and sustaining forces in traditional combat operations. For irregular challenges, this may include deploying and sustaining forces for stability operations, counter-insurgency, special operations direct action, or any of a number of other “non-traditional” military missions.

---

<sup>3</sup> President George W. Bush, *National Security Strategy of the United States of America* (Washington, D.C., 2006), 43-44.

Although Chapter IX directs overall military transformation, a more pressing requirement for Seabasing in particular comes from Chapter VIII (*Develop Agendas for Cooperative Action with the Other Main Centers of Global Power*), Section C. This chapter states that the United States must “be prepared to act alone if necessary.”<sup>4</sup> This is the critical capability that Seabasing is designed to address, by attempting to minimize the US military’s dependence on foreign land bases for supporting power projection forces.

In terms of the 2005 National Defense Strategy (NDS), Seabasing supports the strategic objective (“end,” in strategic parlance) of “Secure Strategic Access and Maintain Global Freedom of Action.”<sup>5</sup> This is to be accomplished by the method (“way”) of “dissuading potential adversaries...by sustaining and developing our own military advantages.”<sup>6</sup> Seabasing helps the Joint Force to “deter aggression and counter coercion” by providing the support structure for “maintaining capable and rapidly deployable military forces and...resolv[ing] conflicts decisively on favorable terms.”<sup>7</sup>

Of the eight key operational capabilities (“means”) given in the NDS, two are most relevant to Seabasing in support the two methods given above. Capability #3, *Operating from the Global Commons*, is fundamental to the principles of Seabasing in that the ability of US forces to be deployed and supported from a sovereign sea base “provides our forces operational freedom of action.”<sup>8</sup> Capability #4, *Projecting and Sustaining Forces in Distant Anti-Access Environments*, is also enabled by the Seabasing

---

<sup>4</sup> Ibid., 37.

<sup>5</sup> U.S. Department of Defense, Office of the Secretary of Defense, Donald H. Rumsfeld, *National Defense Strategy of the United States of America* (Washington D.C., 2005), 6.

<sup>6</sup> Ibid., 7.

<sup>7</sup> Ibid., 8.

<sup>8</sup> Ibid., 13.

concept. The sea base is one potential hub of sustainment support for US forces deployed far from friendly land bases. In summary, Seabasing is strategically well-founded with respect to ends-ways-means in the NDS.

The 2004 National Military Strategy is the next logical level of strategic guidance. Practically, it is somewhat less relevant than it could be, both because it is older than the NSS and NDS, and because it has been largely superseded *de facto* by the 2006 *Quadrennial Defense Review Report* (QDR) as a source of strategic guidance. Keeping that in mind, portions of the NMS are still useful in deriving the strategic foundations of Seabasing. Two of the three military objectives (“ends”) outlined in the NMS are supported by Seabasing. These capabilities support the objective of *Prevent Conflict and Surprise Attack* through the “way” of enabling forward posture and presence by providing sustainment for rotational and temporarily deployed forces in locations where land bases are not available.<sup>9</sup> For the objective of *Prevail Against Adversaries*, Seabasing capabilities may be used to sustain forces across the spectrum of conflict, from stability operations to major combat operations.<sup>10</sup> The Seabasing concept also embodies five of the seven desired Joint Force Attributes outlined in Section III of the NMS: *Fully Integrated, Expeditionary, Networked, Decentralized, and Adaptable*.

While the NSS, NDS, and NMS provide an implied framework in which the Seabasing concept fits, the QDR provides the most specific and directive guidance. The QDR’s importance is in linking the implied tasks in the NSS, NDS, and NMS to specific directive guidance concerned with developing and fielding Seabasing concepts and technologies. Its directive power derives directly from the NSS, which lists the QDR as

---

<sup>9</sup> U.S. Department of Defense, Office of the Joint Chiefs of Staff, Richard B. Meyers, *The National Military Strategy of the United States of America* (Washington, D.C, 2004), 11.

<sup>10</sup> *Ibid.*, 13-14.

the governing document for how the Department of Defense (DoD) will “...adapt and build to meet new challenges.”<sup>11</sup> The QDR designates “[t]he capability to deploy rapidly, assemble, command, project, reconstitute, and re-employ joint combat power from all domains to facilitate assured access” as required to support the objective of “shaping the choices of countries at strategic crossroads” for the purpose of deterring potential aggression.<sup>12</sup>

Seabasing capabilities are referenced directly in two portions of the QDR’s *Reorienting Capabilities and Forces* section. First, under the *Joint Maritime Forces* sub-section, the Navy is directed to procure the first of eight Maritime Prepositioning Ships (Future) and provide for the use of Afloat Forward Staging Bases for Special Operations Forces.<sup>13</sup> Second, under the *Joint Mobility* sub-section, Seabasing is given as a key part of reducing the footprint of forward-deployed forces. The important Seabasing “connector” technology of high-speed sealift is mentioned as well. Most importantly, the DoD is directed to “continue to pursue enabling technologies for transformational logistics and innovative operational concepts such as Seabasing.”<sup>14</sup>

At the service-specific level of strategic thought, Seabasing is part of the most recent *Naval Operations Concept 2006* (NOC), described as one of the nine methods used to fulfill the range of naval missions. Here, US control of the seas is leveraged,

---

<sup>11</sup> *National Security Strategy*, 43.

<sup>12</sup> U.S. Department of Defense, Office of the Secretary of Defense, Donald H. Rumsfeld, *Quadrennial Defense Review Report* (Washington, D.C., 2006), 31.

<sup>13</sup> *Ibid.*, 47-48.

<sup>14</sup> *Ibid.*, 54.

through Seabasing, to provide “operational maneuver and assured access to the joint force.”<sup>15</sup>

Although effectively superseded by the 2006 QDR, the *Naval Transformation Roadmap 2003* (NTR) provides even more specific programmatic and doctrinal guidance for Seabasing. The NTR translates the broad national and DoD-level strategic direction into an operational and programmatic plan for accomplishment, effectively delineating the means to support the national strategic ends. It expands on the previous Sea Power 21 document, listing Seabasing, along with Sea Shield, Sea Strike, and ForceNET, as the “four interdependent and synergistic Naval Capability Pillars” that, taken together, encompass the naval competencies which “form a unified force that assures access and projects both offensive power and defensive capability.”<sup>16</sup> Seabasing contributes to the overall joint force through “support[ing] the Deployment, Employment, and Sustainment continuum...in the Major Combat Operations JOC [Joint Operational Concept]” and as a “critical enabler for the Force Projection required by the Strategic Deterrence JOC and...the Focused Logistics and Joint Command and Control required for Stability Operations.”<sup>17</sup> The NTR provides specific programmatic guidance for Seabasing, linking various programs and technological initiatives to each of the five lines of operation defined in the Seabasing JIC. This guidance includes budgetary expenditure targets, as well as initial and full operational time goals, for five key acquisition programs that support the development of Seabasing capabilities. Also detailed in the NTR are specific

---

<sup>15</sup> U.S. Department of Defense, Office of the Chief of Naval Operations and Headquarters, U.S. Marine Corps, Michael G. Mullen and Michael W. Hagee, *Naval Operations Concept 2006* (Washington, D.C., 2006), 30.

<sup>16</sup> U.S. Department of Defense, Department of the Navy, Gordon R. England, *Naval Transformation Roadmap 2003* (Washington, D.C., 2003), 3.

<sup>17</sup> *Ibid.*, 5.

research and development initiatives that support Seabasing and details about how Seabasing doctrinal concepts are linked into joint experimentation plans for what was the near future.<sup>18</sup>

In summary, the Seabasing concept is well-grounded in national strategic guidance. The concept supports national strategic goals articulated in the NSS and can be traced through each of the DoD strategic documents (the NDS, NMS, and QDR) to the Navy-specific strategic documents (the NTR and NOC). The specific directions contained in the NTR are consistent with achieving the desired goals that Seabasing is designed to support in the NSS.

#### Seabasing – A Historical Perspective

The practice of deploying land forces from ships at sea and then supporting them once ashore is not fundamentally new. In many historical examples, sea-based support was the major—or in some cases the only—source of support for the forces ashore.

For the US Navy, the formative events that solidified the concept of sea-based logistics were the support of sea and land forces during the Pacific campaigns of World War II. The first major example of this was the support of the Marine forces ashore at Guadalcanal in the fall and winter of 1942-1943. Being the first attempt to mount such a large-scale operation far from friendly bases within the institutional memory of the Navy and Marine Corps, many problems were encountered. Most of these problems, such as failure to combat-load the assault forces' transports and surpluses/shortages caused by inaccurate estimation of consumption rates, stemmed from lack of experience and planning. This was complicated by the distance from Guadalcanal to the nearest support

---

<sup>18</sup> Ibid., 56-64.



base (about 900 miles to Noumea, which itself was over 3,000 miles from Pearl Harbor) and the impact of enemy action on delivering supplies to the front.<sup>19</sup>

Sea-based logistics evolved dramatically in response to the challenges observed in this early campaign, and was critical to the success of later campaigns, particularly in the central Pacific. For example, during the invasion of Iwo Jima early in 1945, a force of more than eight hundred ships of all sizes and three divisions of ground troops in combat were effectively deployed and supported for a seven-week campaign encompassing some of the most intense combat seen in the Pacific theater. In this case, the nearest support bases were over 500 miles away in the Marianas Islands (Guam, Tinian, and Saipan), although the vast majority of the fleet support units were about 1,000 miles away, operating from an anchorage in Ulitihi atoll.<sup>20</sup> The support force at Ulitihi (Service Squadron TEN) consisted of over 250 vessels and “supplied practically every form of service as would be available at a navy yard or supply depot on the continent.”<sup>21</sup> Despite the large distances and scale of the effort, no significant logistical problems were encountered. Although there are many technical logistics lessons can be learned from these endeavors, the significant strategic lesson is that given a large enough investment in equipment, adequate training, and a relatively benign environment, large land forces can be successfully supported by sea for extended campaigns.

A more recent example of large-scale sea-based logistics is *Operation Corporate*, the UK campaign to retake the Falkland Islands from Argentina in 1982. The British deployed thirty-four warships, eight amphibious ships, twenty-one fleet auxiliaries, fifty

---

<sup>19</sup> Worrall R. Carter, *Beans, Bullets and Black Oil: The Story of Fleet Logistics Afloat in the Pacific During World War II* (Washington, D.C, 1953; reprint, Newport, RI: Naval War College Press, 1998), 26, 38-39.

<sup>20</sup> Ibid., 281-283.

<sup>21</sup> Ibid., 286.

requisitioned civilian ships (ships taken up from trade—STUFT), and two brigades of troops for the campaign.<sup>22</sup> The nearest friendly base was Ascension Island, about four thousand miles from the Falklands. Although the campaign was ultimately successful, the British logistics support was stretched to the very limit to make this possible. Three significant lessons can be learned for future Seabasing operations from the Falklands campaign.

First, without the ability to requisition and rapidly refit STUFT, the Royal Navy would not have had adequate strategic lift to accomplish the operation. The ability to use STUFT, with their civilian merchant marine crews, for combat roles such troop transport, aircraft ferries and minesweepers was absolutely critical.<sup>23</sup> This is a notable concern for US sealift policy, as the same freedom of employment is typically not possible with leased third-party ships and the number of US-flagged ships available may not be adequate.

The second significant challenge faced by the British forces was the inability to adequately protect their support ships. All of the logistics for the ground forces were supplied from support ships anchored in San Carlos Water, with minimal stockpiles ashore in Ajax Bay. These support ships needed to be kept very close to the invasion beach in order to provide the required support. The requirement to keep the support ships in this confined space for such a long time made them very vulnerable to Argentinean air attacks. Three of the eight amphibious ships were hit during the conflict by bombs, with

---

<sup>22</sup> U.S. Department of Defense, Department of the Navy, *Lessons of the Falklands Summary Report February 1983* (Washington, D.C., 1983), Appendix B.

<sup>23</sup> Henry Leach, "Crisis Management and Task Force Assembly," in *The Falklands Conflict Twenty Years On: Lessons for the Future*, ed. Stephen Badsey, Rob Havers, and Mark Grove (London: Frank Cass, 2005), 73.

one of the three sunk.<sup>24</sup> The ability to adequately protect the ships of the sea base from enemy attack is crucial to the success of any Seabasing-supported operation.

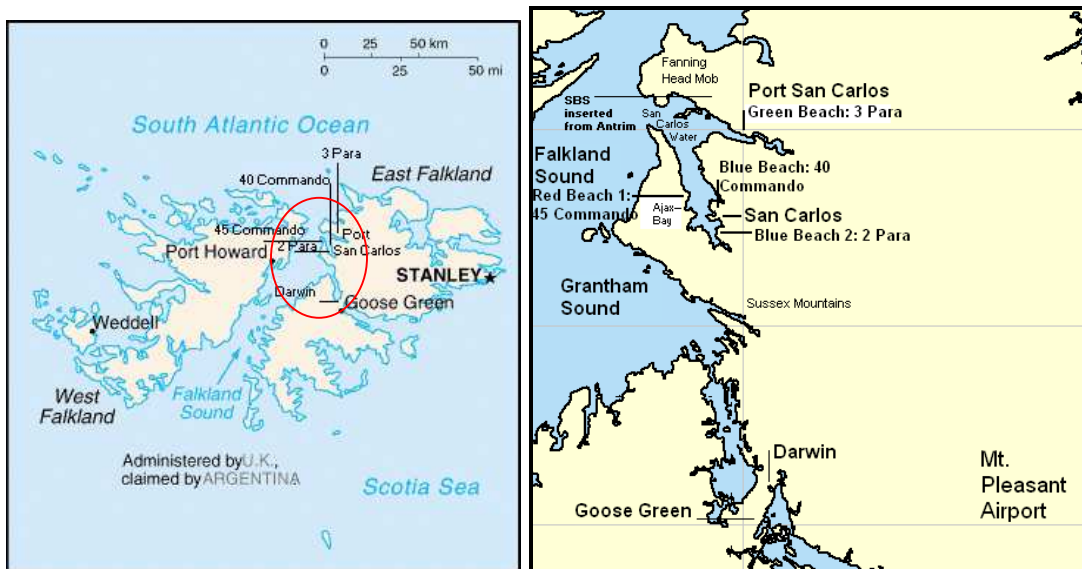


Figure 1 – British Landing Areas in the Falkland Islands

The third take-away from the Falklands campaign was the lack of adequate “connectors.” Severe shortages of helicopters, exacerbated by the loss of the STUFT container ship *Atlantic Conveyor* and her embarked Chinooks, dramatically limited the ability to move supplies from the beachhead to forces further inland. Logistics troops were forced to use whatever could be acquired, including landing craft, small rigid hull inflatable boats, and commandeered trucks when lift was not available.<sup>25</sup> In many cases this was not possible, and supplies simply did not get out, or had to be carried on foot.

<sup>24</sup> I.J. Hellberg, “Logistics for Commandos of the Royal Marines,” in *The Falklands Conflict Twenty Years On*, 116, 121.

<sup>25</sup> *Ibid.*, 116, 120.



Figure 2 – *Atlantic Conveyor*

Several US operations in the past five years have had significant Seabasing components. The largest was during *Operation Enduring Freedom*, when Special Operations Forces (SOF) and Marine units embarked on USS *Kitty Hawk* and accompanying expeditionary strike group ships underway in the Gulf of Oman executed “the longest ship-to-objective maneuver in history, moving 400 miles inland to seize the desert airstrip south of Kandahar.”<sup>26</sup> However, some blemishes were seen in this implementation of the Seabasing concept. First, the use of USS *Kitty Hawk* as a Seabasing platform required the removal of almost her entire normal air wing complement, rendering her ineffective as a strike or fleet defense platform. This highlights the need to procure dedicated Seabasing ships, rather than employing a (very) expensive CV/CVN to fill that role. Second, the “connectors” used for this operation (primarily CH-53 and CH-46 airframes) required fueling stops in Pakistan en route to and

<sup>26</sup> *Naval Operations Concept 2006*, 28.

from Afghanistan. Contrary to the Seabasing principles, this required at least *de facto* cooperation from Pakistan. Longer-ranged connector aircraft must be employed to maximize the value of Seabasing.

The Seabasing concept is one that is well-founded in both national strategic guidance and in historical precedent. It is an evolutionary development of a long-practiced naval mission that is both strategically relevant and operationally useful in the current and near- to mid-term security environment. Enabling the Joint Force commander to conduct sustained, large scale land operations well inside hostile territory, with minimum logistical footprint on the ground, Seabasing significantly increases the agility of the joint force. Because the fundamental idea behind Seabasing is not a new one, many valuable lessons that can be learned from examining past Seabasing-style operations can be applied to the doctrine, equipment procurement, and execution of Seabasing operations in the future.

#### Seabasing Specifics and Nominal Case Description

The Seabasing concept, as outlined in the JIC and NWP, can be scaled across the range of military operations from a very small-scale application, such as would support a SOF operation in a very permissive environment, to the largest-scale application, which would be supporting a division-sized land force component in major combat operations against a near-peer competitor.<sup>27</sup> Operations at the smaller end of this scale are not very demanding in terms of the size of the force supported and, thus, are generally capable of being conducted using currently-fielded systems. In order to really see the unique, evolutionary capabilities that are called for by Seabasing, one must look at employing the

---

<sup>27</sup> NWP SEABASING, pp. 8-1 to 8-10.

concept on a larger scale than that routinely performed by Expeditionary Strike Groups (ESGs) and Marine Expeditionary Units (MEUs) today.

For the purposes of this study the nominal case for a Seabasing force structure will be that construct capable of closing, assembling, employing, sustaining, and reconstituting a brigade-sized land force component, such as a Marine Expeditionary Brigade (MEB) or Army Stryker Brigade.<sup>28</sup> This nominal force structure concept corresponds to the “Large Sea Base” notional Seabasing scenario in the Seabasing NWP.<sup>29</sup> It fulfills all attributes of the “top-level measures of performance threshold” detailed in the JIC (to be used for Joint experimentation and Capabilities Based Assessments) except it would be able to sustain only one, vice two, brigades ashore.<sup>30</sup> This is also the same construct as was used by the Defense Science Board Task Force in its study of Seabasing.<sup>31</sup> This brigade-sized Seabasing force would have the basic attributes outlined in the remainder of this section. These attributes set the parameters by which various technological solutions will be evaluated later (see Methodology, below).

The Seabasing force must be capable of bringing all of the Joint Force components required to support major combat operations to the joint operating area (JOA) within a time span of ten to fourteen days from the execution order. As the heavy-lift ships of the Seabasing force would be located no more than 2,200 nautical miles (nm) from the JOA at the time of execution, this translates to a minimum average deployment

---

<sup>28</sup> These five functions are the “Seabasing Lines of Operation” as outlined in both *NWP SEABASING*, p. 1-6, and *Seabasing Joint Integrating Concept*, 7.

<sup>29</sup> *NWP SEABASING*, pp. 8-3 to 8-4.

<sup>30</sup> *Seabasing Joint Integrating Concept*, 8. Supporting a one- or two-brigade force ashore is a matter of scaling. Providing support to a second brigade would require providing additional staging platforms and connectors to the Seabase. In order to maintain consistency with the scenarios outlined in then NWP and Defense Science Board Task Force report, this analysis will use the one-brigade construct.

<sup>31</sup> U.S. Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, William Schneider, Jr., chairman, *Defense Science Board Task Force on SEA BASING* (Washington, D.C., 2003), 13.

speed of about 6.5 knots (assuming immediate departure upon the execute order and fourteen days to arrive).<sup>32</sup> For a somewhat more realistic deployment timeline (forty-eight hours from execute order to departure and ten days to arrive), this gives an upward bound on average speed of almost 11.5 knots. Since aircraft and high-speed vessel transit speeds are typically much greater, this minimum speed only a consideration for the large ships of the Seabasing force.

Within twenty-four to seventy-two hours of arrival in the JOA, the Seabasing force must be able to complete any required reception, staging, onward movement, and integration (RSOI) and be ready to conduct operational maneuver.<sup>33</sup> This requires the ability to transfer personnel and equipment between vessels in the Seabasing force as well as to selectively access and offload items from storage locations. For example, the arrival and closure of the Joint Force may include receiving personnel from CONUS locations via one or more different high-speed connector vessels and distributing them to various platforms in the Seabasing force to marry up with their equipment, breaking out and preparing equipment for operations, and the combat-loading of both troops and equipment onto assault vehicles.

The Seabasing force must be able to deploy its brigade-sized land component directly to an enemy-protected objective from over-the-horizon during a single period of darkness. For aircraft connectors, this means a combat deployment range of about 150 nm from shore, or at least 175 nm from the Seabasing force ships.<sup>34</sup> For surface connectors, this deployment range may vary from 25 nm up to 150 nm, depending upon the capability of the enemy forces to threaten the Seabasing force ships with aircraft,

---

<sup>32</sup> *NWP SEABASING*, p. 8-5; *Seabasing Joint Integrating Concept*, 8.

<sup>33</sup> *Seabasing Joint Integrating Concept*, 8.

<sup>34</sup> *Defense Science Board*, 33.

mines, anti-ship cruise missiles or other anti-access measures. A minimum range of 25 nm is required to keep the Seabasing force ships over the radar and visual horizon from hostile ground-based observation, helping to contribute to tactical surprise.<sup>35</sup> A longer range, upwards of 150 nm, would be desirable against an enemy force with robust anti-access capabilities, in that it would provide the Seabasing force more time to defensively react to enemy attacks against the force.<sup>36</sup>

For sustainment capability, the Seabasing force must be able to indefinitely support a brigade-sized joint force ashore. During this sustainment, the Seabasing force may be located up to 2,000 nm away from the nearest friendly advanced logistics support site (ALSS) and as much as 200 nm from the combat forces ashore being supported.<sup>37</sup> Instead of building up significant stocks of supplies on shore, needed materials would be delivered directly from the Seabasing force's ships to the operating forces.<sup>38</sup> In addition to possessing the air and surface connectors to deliver supplies ashore, the Seabasing force will require other connectors (air, high speed surface, or conventional ship) to move supplies from CONUS or the ALSS to the Seabasing force. Supplies (ammunition, food, fuel, water, repair parts, etc) will be received at the sea base, selectively broken down and stored, then transferred ashore as required to support the Joint Force.

The amount of material to be provided is substantial. It is projected that a MEB-sized force conducting intense combat operations will have a daily logistics requirement of up to 95 tons of provisions, 688 tons of ammunition, and 1,595 tons of fuel per day.<sup>39</sup>

---

<sup>35</sup> Ibid., 48.

<sup>36</sup> Ibid., 39.

<sup>37</sup> Ibid., 78.

<sup>38</sup> *Seabasing Joint Integrating Concept*, 22.

<sup>39</sup> Stephen L. Kennedy, "An Analysis of Alternatives for Resupplying the Sea Base" (Master's thesis, Monterey, CA: Naval Postgraduate School, 2002), 12.



Logistics personnel must have complete visibility and random access to all stores to ensure that the right material gets to the right people at the right time. The Seabasing force will also be required to supply limited maintenance and medical support to the forces ashore, including retrograde capabilities for casualties and damaged equipment back to the ALSS and/or CONUS.<sup>40</sup>

Finally, the Seabasing force must be able to recover the deployed land component, reconstitute the force afloat, and redeploy the force for future operations in another JOA. The expected transfer distances for the deployed forces back to the Seabasing force would be expected to be similar to those at which the forces deployed. Reconstitution of the force can be expected to include repair and maintenance as well as wash down or decontamination of equipment. The capacity to handle equipment that has been exposed to chemical, biological, or nuclear contamination may also be required.<sup>41</sup>

In order to provide reliable support to forces in combat ashore, Seabasing must be as weather-independent as possible. This requires that all of the functions given above must be able to be conducted without interruption in moderate seas. This will require the ability to safely launch and recover tactical and connector aircraft, transfer to and from surface connectors, and transfer between Seabasing force staging platforms in sea states up to and including sea state four.<sup>42</sup>

The nominal case described here is a challenging one that requires the full panoply of capabilities that Seabasing could bring to the Joint Force. Although one could easily imagine more permissive scenarios where this full range of capabilities would not be needed to accomplish the mission, this hypothetical construct is the smallest and

---

<sup>40</sup> *Seabasing Joint Integrating Concept*, 8.

<sup>41</sup> *NWP SEABASING*, pp. 7-1 to 7-5.

<sup>42</sup> *Seabasing Joint Integrating Concept*, 27.

simplest one that fully exploits all of the evolutionary capabilities that Seabasing brings over and above traditional amphibious warfare. Some capabilities that would be needed for a scenario like this, such as missile/air defense systems, sensors, command and control systems, fire support, mine clearance and the like, are incorporated in the Sea Shield, Sea Strike, or ForceNET concepts. These will not be considered here. What will be evaluated are the five key Seabasing-specific capability areas where the development of new technologies and the fielding of new systems are required for the Seabasing concept to reach its full potential. These five key capability areas are staging platforms, aircraft connectors, surface connectors, bulk cargo transfer at sea and inter-ship interfaces, and logistics support systems.

THIS PAGE INTENTIONALLY LEFT BLANK

### **Methodology for Analyzing Alternatives to Satisfy Key Capabilities**

In evaluating various options to fulfill each of the key capability areas outlined above, a standard analytical framework must be established. For each of the capability areas, one or more potential solutions that have been planned or developed will be described. Each of these potential solutions will be evaluated and quantified in each of four different areas: utility to the Seabasing concept, utility to the Joint Force outside of the Seabasing concept, developmental status, and cost to field. The results of these evaluations will be compiled to determine an overall score for each potential solution. This overall score will then be used to construct a recommended priorities list. The key to ensuring that this analysis is valuable is the development of an adequate system of metrics for the potential solutions in each of the four different areas.

#### Seabasing Utility

First, the utility of the potential solution to the Seabasing concept must be evaluated. The specifics of how this will be measured different for each capability area, based on what characteristics are required for that capability.

#### *Seabasing Utility Metrics for Staging Platforms*

For staging platforms, the important metrics are speed, cargo capacity, vehicle capacity, troop capacity, aircraft capacity, and surface connector capacity. Speed is scored by assigning the potential staging platform one point for every 5 knots of maximum sustained speed, with a maximum score of four points (equating to 20 knots).

For each of the capacity metrics, a score from one to ten will be assigned, based how big a fraction of the lift required to support a notional 2015 Marine Expeditionary Brigade (MEB) is supplied by the platform. The capacity required in each of these areas to transport the 2015 MEB is shown in Table 1. Cargo capacity is measured in cubic feet of storage space. Vehicle capacity is measured in square feet of space available for vehicles. Troop capacity is measured in total number of landing force troops carried (officers and enlisted), including any “surge” capacity that the platform may possess. Aircraft capacity is measured by the number of “CH-46 equivalent spots” that the platform can support. It is important to note that this is a measurement of maximum total aircraft carrying capacity, including hanger decks, and not of flight deck space or the number of aircraft typically assigned. This metric is the current standard used by the Marine Corps for measuring the aircraft carrying capacity of various ships.<sup>43</sup> Similar to aircraft capacity, surface connector capacity is measured by the number of “LCAC-equivalent” spots that the platform can support.

Cargo	560,000	Cubic feet
Vehicles	300,000	Square feet
Troops	12,700	Personnel
Aircraft	260	“CH-46 equivalent” spots
Surface Connectors	31	“LCAC equivalent” spots

**Table 1 – Lift Requirements for Notional 2015 Marine Expeditionary Brigade<sup>44</sup>**

<sup>43</sup> Robert Button et al., *A Preliminary Investigation of Ship Acquisition Options for Joint Forcible Entry Operations* (Santa Monica, CA; RAND, 2005), 31.

<sup>44</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 43.

The score assigned for each capacity area is determined by taking the capacity provided by the potential staging platform, dividing that number by the capacity required for the MEB, multiplying the result by ten and rounding to the nearest whole number.<sup>45</sup>

### *Seabasing Utility Metrics for Aircraft Connectors*

For aircraft connectors, the three key parameters that are scored are cargo capacity, speed, and range. Aircraft connector cargo capacity (measured in short tons), range (in nautical miles), and speed (in knots), are linked in that the range is the unrefueled tactical radius while carrying the specified cargo load, at the specified speed. In order to carry the current Army Stryker vehicles and projected Army FCS, an aircraft connector should have a capacity of at least twenty tons.<sup>46</sup> Given the Seabasing concept described above, it should be able to lift this load to an unrefueled radius of 200 nm from the staging platform. Finally, an aircraft connector should be able to keep up with the troop carrying aircraft, which will most likely be the V-22 Osprey or some variant thereof. This would give a speed requirement of about 250 mph (217 knots).<sup>47</sup> Similar to the how the capacity scores for the staging platforms are calculated, the score assigned for each of these metrics is determined by taking the capacity provided by the potential aircraft connector, dividing that number by the capacity desired (as outlined above), multiplying the result by ten and rounding to the nearest whole number. Additionally, aircraft connectors are also scored based on whether or not the solution is capable of

---

<sup>45</sup> For all the capacity measurements, the values used are those that the platform can support simultaneously, without degrading capacity in other areas. In other words, it can carry the listed quantity of troops, vehicles, aircraft, surface connectors and cargo.

<sup>46</sup> John Gordon IV et al., *Assessment of Navy Heavy-Lift Aircraft Options* (Santa Monica, CA: RAND, 2005), 24.

<sup>47</sup> Christian F. M. Liles and Christopher Bolkcom, *Military Helicopter Modernization: Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 2004), 41.

vertical take-off and landing (VTOL) and whether or not the solution is capable of in-flight refueling, with ten points being awarded for solutions that have each of these capabilities.

### *Seabasing Utility Metrics for Surface Connectors*

Surface connectors share many of the same key parameters as aircraft connectors. Specifically, cargo capacity, range, and speed are all important. Ideally, a surface connector should be capable of transporting two of the heaviest combat vehicles in the inventory (currently the M1A2 Abrams tank, with a weight of seventy tons<sup>48</sup>) a distance of 150 nm, at a speed of fifty knots. Similar to the how the capacity scores for the staging platforms and aircraft connectors are calculated, the score assigned for each of these metrics is determined by taking the capacity provided by the potential surface connector, dividing that number by the capacity desired (as outlined above), multiplying the result by ten and rounding to the nearest whole number. Since surface connectors must operate from the staging platforms at sea to the land forces ashore, the ability for a surface connector to be fully amphibious is valuable. Surface connectors that are fully amphibious will be awarded an additional ten points. Those that are capable of unloading directly onto a beach, but are not fully amphibious, will be awarded five points.

---

<sup>48</sup> *M1A2 Abrams: Main Battle Tank* brochure (Sterling Heights, MI: General Dynamics Land Systems, 2003) accessed at <http://www.gdls.com/programs/m1a2.html> on 19 February 2007.

### *Seabasing Utility Metrics for At-Sea Bulk Cargo Transfer*

For at-sea bulk cargo transfer technologies, the key characteristics required for Seabasing are the maximum load able to be transferred, the throughput capacity of the transfer system, and the maximum sea state at which full-capacity transfers can safely be maintained. The ability to transfer loads as large as a fully-loaded forty-foot International Organization for Standards (ISO) compliant intermodal container, weighing up to thirty-five tons, is desirable.<sup>49</sup>

Estimating the required throughput capability for a particular transfer technology requires making some assumptions about how replenishment operations would be conducted. As stated in the previous section, a MEB-sized force conducting intense combat operations may require up to 783 tons/day of provisions and ammunition. Assuming an average container would carry twenty tons, about forty containers would be needed. Assuming eight hours per day are dedicated to cargo transfer, about five containers per hour would need to be transferred.<sup>50</sup> As was outlined in the previous section, the Seabasing concept requires the ability to sustain forces ashore in all but the most extreme of sea conditions. As such, the goal for cargo transfer systems is to be able to safely operate at full capacity in up to sea state four.

Similar to the how the capacity scores for the staging platforms and connectors are calculated, the score assigned for each of these metrics is determined by taking the capacity provided by the potential cargo transfer technology, dividing that number by the capacity desired (as outlined above), multiplying the result by ten and rounding to the

---

<sup>49</sup> U.S. Department of Defense, Office of the Joint Chiefs of Staff, *Joint Pub 4-01.7: Tactics, Techniques, and Procedures for Use of Intermodal Containers in Joint Operations* (Washington D.C., 1997), p. II-6.

<sup>50</sup> Shore side container facilities with purpose-designed container cranes can transfer up to thirty containers per hour per crane, according to Kennedy, "An Analysis of Alternatives for Resupplying the Sea Base," 20.



nearest whole number. Additionally, the ability to transfer ISO-compliant twenty- and forty-foot intermodal containers is valuable. Systems that can handle twenty-foot containers will be awarded five points. Systems that can handle both twenty- and forty-foot containers will be awarded ten points.

### *Seabasing Utility Metrics for Logistics Support Technologies*

Logistics support technologies must provide four key capabilities to Seabasing. These are the ability to randomly, selectively, access and offload any required item (selective offload); the ability to provide full in-transit visibility of all material in the pipeline at any time; the ability to support the use of ISO-standard twenty- and forty-foot intermodal containers; and the ability operate modularly. Each logistics support technology solution will be assessed as to how well it satisfies these four key capability areas. Proposed solutions that fully support an area will be awarded ten points. Proposed solutions that only partially support an area will be awarded five points.

### Joint Force Utility

Second, the utility of the potential solution to the Joint force in areas outside the Seabasing concept must be evaluated. This will be evaluated by examining how each solution contributes to each of the Joint Operating Concepts (JOC) outside of the Seabasing construct. Solutions that replicate existing capabilities from this point of view will be awarded three points. Solutions that provide an improvement to an existing capability will be awarded six points. Solutions that provide a new, relevant capability will be awarded ten points. This evaluation will be repeated for each of the JOCs:

Homeland Defense and Civil Support; Deterrence Operations; Major Combat Operations; Military Support to Security, Stability and Reconstruction Operations; Irregular Warfare; and Shaping Operations.<sup>51</sup> Values for each JOC will be totaled to provide the solution's composite score for utility outside of Seabasing.

### Developmental Status

Third, the current state of development of the potential solution must be determined. The current state of development directly drives two important variables—the time until the solution reaches operational capability and the risk (technical and financial) associated with pursuing the solution. Scoring for development will be done on a fifty point scale, with more points being given for solutions that are further along in the development and procurement process. For potential solutions that are currently only in the conceptual phase, ten points will be awarded. Potential solutions that are undergoing research and development, but have not reached the functional prototype stage, will be awarded twenty points. Solutions that have reached the point where a complete, functional prototype has been created will be awarded thirty points. For potential solutions that exist, for the most part in a complete configuration as would be required for Seabasing, and are in use in the civilian sector or with another country's military, forty points will be awarded. Solutions that are currently in use to any extent somewhere within the US military or US government will be awarded the maximum of fifty points.

---

<sup>51</sup> U.S. Department of Defense, Office of the Joint Chiefs of Staff, J7 Joint Experimentation, Transformation and Concepts Division, *Joint Transformation and Concepts* [Microsoft PowerPoint presentation] (Washington D.C., 2007), slides 2-3, accessed at <http://www.dtic.mil/futurejointwarfare/concepts/status.ppt> on 16 February 2007.

### Cost to Field

Finally, the cost to develop and field each of the potential solutions needs to be determined. In order to provide a standard measurement, this fielding cost will be for the amount of material required to support a single brigade-sized unit (MEB or Army Stryker brigade) in accordance with the JIC and NWP. For solutions that already exist in the force, this value will be the actual cost of procurement. For solutions that do not already exist, the best estimate of cost of procurement will be used. Unless otherwise specified, all costs referenced in this document are in FY07 dollars and have been converted from then-year dollars using the Inflation Calculator workbook provided by the Naval Center for Cost Analysis, using the appropriate weighted inflation index for the type of expenditure (Shipbuilding & Conversion, Navy; Aircraft Procurement, Navy; or National Defense Sealift Fund).<sup>52</sup> Scoring for cost will be done using a point scale, with more points being given for solutions that are less expensive in terms of total deployment cost. Programs with a total cost to field of up to \$500 million will be awarded the maximum of fifty points. If the total cost to field is \$500 million to \$1 billion, forty points will be awarded. Similarly, if the estimated total cost is \$1 billion to \$2 billion, thirty points will be awarded. Twenty points will be awarded if the cost will be \$2 billion to \$4 billion and ten points if the cost will be \$4 billion to \$8 billion. Zero points will be awarded for programs costing over \$8 billion.

---

<sup>52</sup> U.S. Department of Defense, Naval Center for Cost Analysis, *Inflation\_Calc\_FY08\_Ver\_1.xls* [Microsoft Excel worksheet] (Washington, D.C., 2007) accessed at <http://www.ncca.navy.mil/services/inflation.cfm> on 21 February 2007.

## Evaluation of Potential Solutions to Key Capabilities

### Key Capability Area #1 – Staging Platforms

The first key capability area that will be examined for potential solutions is that of staging platforms. These are the ships that form the core of the Seabasing concept, providing the heavy lift, force closure and transshipment locations, and reconstitution capabilities for the Seabased forces. Many options have been proposed for staging platforms, some of which are current vessels and some of which are in various stages of design and procurement. Fourteen different vessel options will be analyzed in this study: LHA, LHD, LHA(R), LPD 4, LPD 17, LSD 41, LSD 49, MLP, T-AKR, T-AKE, Legacy T-AK, MPF 2010, “Sea Force,” and Maersk S-Class Conversion.

A fully-formed Seabasing capability will include several of these potential solutions. Although Seabasing force compositions are still evolving, the current doctrinal construct would require an Expeditionary Strike Group (one LHA or LHD, one LPD, one LSD, and combatant escorts) to be combined with an Maritime Prepositioning Force (Future) Squadron (two LHA(R), one LHD, three T-AKR, three MLP, three T-AKE, and two Legacy T-AK) in order to close a MEB-sized land force for a forcible entry scenario.<sup>53</sup> Appendix 1 summarizes the results of this analysis.

#### *Tarawa-class (LHA 1)*

The *Tarawa*-class LHA is a large amphibious assault ship, with a full-sized flight deck and well deck. It is designed to transport a significant portion of a MEU’s troops, equipment, and supplies; be a base of operations for rotary wing/VTOL aircraft and

---

<sup>53</sup> NWP SEABASING, p. A-10.

landing craft; and provide facilities for command and control of amphibious operations. The five ships of the *Tarawa*-class were commissioned between 1976 and 1980 and are in the process of being retired, starting with the USS *Belleau Wood* (LHA 3) in 2005, to be replaced on a one-for-one basis by LHD 8 and the first four LHA(R)s.

In terms of Seabasing capabilities, the *Tarawa*-class LHAs provide significant capabilities in terms of cargo space, troop capacity, and aviation capabilities. Table 2 summarizes how much capability the *Tarawa*-class has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *Tarawa*-class has a composite Seabasing Utility score of eleven points.

Metric	LHA Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	156,000	560,000	Cubic feet	3
Vehicles	28,700	300,000	Square feet	1
Troops	1,902	12,700	Personnel	1
Aircraft	43	260	"CH-46 equivalent" spots	2
Surface Connectors	1	31	"LCAC equivalent" spots	0
Speed	24	20	Knots	4

Table 2 – LHA Seabasing Utility<sup>54</sup>

The *Tarawa*-class provides some capabilities to areas outside of Seabasing. For Homeland Defense and Civil Support (HD/CS) it provides a mobile base of operations for humanitarian assistance, disaster relief, and consequence management. This role is

<sup>54</sup> U.S. Department of Defense, Marine Corps Combat Development Command, *Marine Corps Reference Publication (MCRP) 3-31B, Amphibious Ships and Landing Craft Data Book* (Washington D.C., 2001), 3-5.

not unique to the LHA and other ships as well as facilities ashore may provide the same sorts of support to HD/CS operations. Therefore, three points are awarded for HD/CS. With respect to Deterrence Operations, the power projection capabilities provided by the LHA, operating as part of a rotationally or surge deployed Expeditionary Strike Group, is both unique and relevant. Thus, ten points are awarded for Deterrence Operations.

Outside of forcible entry and Seabasing scenarios, the LHA provides only limited support to Major Combat Operations (MCO), primarily as an auxiliary aviation platform for sea control, counter-mine, and undersea warfare missions. As this role is primarily filled by aircraft carriers and surface combatants, only three points are awarded to the LHA for MCO.

Amphibious ships such as the LHA only provide peripheral support for Military Support to Security, Stability and Reconstruction Operations (SSTR), as either strategic sealift to bring troops, equipment and humanitarian assistance to the area of operations and/or as an aviation operation platform. In either case, this role is duplicated by other solutions such as commercial or dedicated strategic lift assets or a shore facility for air operations. Therefore, three points are awarded for SSTR.

Amphibious ships like the LHA provide an Afloat Forward Staging Base (AFSB) for Irregular Warfare (IW). Although the roles filled by and AFSB may be replicated ashore, the abilities to conduct IW operations without requiring host nation approval for force basing and the improved force protection afforded by being at sea are enough of an improvement over shore facilities to earn the LHA six points for IW.

LHAs and other “gray hull” amphibious ships routinely fill forward presence and security cooperation roles around the world in support of Shaping Operations. Since this

role may also be performed by other joint operational forces, only three points are awarded to the LHA for Shaping Operations. Overall, the LHA has a composite Joint Utility score of twenty-eight points.

As the LHA is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the LHA is awarded fifty points for Development Status.

The LHAs were constructed in the 1970s for a cost of \$764.6 million.<sup>55</sup> As outlined above, the NWP concept for a MEB-sized Seabasing force consists of one ESG and a Maritime Prepositioning Force (Future)—MPF(F)—squadron. Since only one LHA is required as part of this force structure, the total cost to field is also \$764.6 million. This results in a Cost to Field score of forty points.

#### *Wasp-class (LHD 1)*

The *Wasp*-class LHD is also a large amphibious assault ship, one with a full-sized flight deck and well deck. An evolution of the LHA design, it is designed fill the same roles as the LHA, with improvements in the command and control systems, ability to support aircraft, and number of landing craft carried. The eight ships of the *Wasp*-class were commissioned starting in 1989, with the final ship, USS *Makin Island* (LHD 8) scheduled to be commissioned in 2007. The LHDs are expected to be in the force until at least the late 2020s.

---

<sup>55</sup> In FY07 dollars. Total LHA contract cost for all five ships was \$1,462 million in FY78 dollars. This cost was divided by five and converted to FY07 dollars. U.S. General Accounting Office, Comptroller General, *Report to the Congress on the 1978 Navy Shipbuilding Claims Settlement at Litton/Ingalls Shipbuilding—Status as of August 1, 1982* (Washington, D.C., 1982), 3.

In terms of Seabasing capabilities, the *Wasp*-class LHDs also provide significant capabilities in terms of cargo space, troop capacity, and aviation capabilities. In comparison to the LHA, they have significantly more room for surface connectors, with a small reduction in cargo and vehicle space. Aviation and troop capacities are substantially similar. Table 3 summarizes how much capability the *Wasp*-class has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *Wasp*-class has a composite Seabasing Utility score of thirteen points.

Metric	LHD Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	145,000	560,000	Cubic feet	3
Vehicles	24,012	300,000	Square feet	1
Troops	2,104	12,700	Personnel	2
Aircraft	42	260	“CH-46 equivalent” spots	2
Surface Connectors	3	31	“LCAC equivalent” spots	1
Speed	22	20	Knots	4

Table 3 – LHD Seabasing Utility<sup>56</sup>

The utility provided by the *Wasp*-class to the Joint Force outside of Seabasing is essentially identical to that provided by the *Tarawa*-class. Therefore, the LHD is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LHD has a composite Joint Utility score of twenty-eight points.

<sup>56</sup> *Amphibious Ships and Landing Craft Data Book*, 6-8.



As the LHD is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the LHD is awarded fifty points for Development Status.

The unit cost of the most recent LHD was \$1,205.5 million.<sup>57</sup> Since two LHDs are required to support the MEB Seabasing force, the total cost to field is \$2,411 million. This results in a Cost to Field score of twenty points.

### *LHA(R)*

Designed to both replace the *Tarawa*-class LHAs and incorporate design features specific to Seabasing, the Replacement LHA, LHA(R), has been the subject of considerable controversy over the past few years. The currently-proposed design, at least for the first ship in the class, is an evolution of the LHD design. The most significant changes from the LHD are that the well deck has been completely removed and the amounts of vehicle space and troop capacity have been reduced by about half. The purpose of this change is two-fold: to provide for more hanger volume to be able to handle the larger F-35, MV-22, and CH-53K aircraft; and to provide more volume for carrying aviation fuel. The LHA(R) retains the command and control capabilities of the LHD.

In terms of Seabasing capabilities, the LHA(R) is primarily focused on aviation support. It also provides significant capabilities in terms of cargo space and some capacity for troops and vehicles. Table 4 summarizes how much capability the LHA(R) has compared to the each of the Seabasing metrics, as well as the class's resulting

---

<sup>57</sup> U.S. Department of Defense, Department of the Navy, *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion*, Navy (Washington, D.C., 2007), p. 16-1.

Seabasing Utility score. Overall, the LHA(R) has a composite Seabasing Utility score of nine points.



**Figure 3 – LHA(R) Concept Design<sup>58</sup>**

Metric	LHA(R) Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	125,000	560,000	Cubic feet	2
Vehicles	12,000	300,000	Square feet	0
Troops	1,102	12,700	Personnel	1
Aircraft	45	260	“CH-46 equivalent” spots	2
Surface Connectors	0	31	“LCAC equivalent” spots	0
Speed	20	20	Knots	4

**Table 4 – LHA(R) Seabasing Utility<sup>59</sup>**

<sup>58</sup> U.S. Department of Defense, *Program Acquisition Costs by Weapons System: Department of Defense Budget for Fiscal Year 2008* (Washington, D.C., 2007), 55.

<sup>59</sup> Eric J. Labs, *The Future of the Navy’s Amphibious and Maritime Prepositioning Forces* (Washington, D.C.: Congressional Budget Office, 2004), 20.

The utility provided by the LHA(R) to the Joint Force outside of Seabasing is essentially identical to that provided by the *Tarawa*-class and *Wasp*-class ships.

Therefore, the LHA(R) is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LHA(R) has a composite Joint Utility score of twenty-eight points.

The LHA(R) is a modification of an existing design that does not incorporate any substantially new or unproven technology; the existing LHDs can be considered “prototypes” of the LHA(R) design. Thus, the LHA(R) is awarded thirty points for Development Status.

The projected unit cost for the first LHA(R) is expected to be \$2,806.2 million.<sup>60</sup> Since two LHA(R)s are required to contribute to the MEB Seabasing force, the total cost to field is \$5,612.4 million. This results in a Cost to Field score of ten points.

#### *Austin-class (LPD 4)*

The *Austin*-class LPD is an older amphibious transport dock, smaller than the LHA/LHD-type ships and an evolution of World War II-era amphibious ship designs. The ship has a large well deck that is covered by a helicopter flight deck, although the *Austin*-class does not possess a hanger deck and the flight deck is primarily used as an operating platform for helicopters based on other ships. It is designed carry significant amounts of cargo, vehicles, troops, and landing craft. In the current ESG construct, an LPD such as the *Austin*-class will accompany an LHD or LHA and an LSD. Together,

---

<sup>60</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion, Navy*, p. 19-1.

the three ships will carry a complete MEU. The LPD 4 does not have the same level of command and control systems as the larger amphibious ships. The twelve ships of the *Austin*-class were commissioned between 1961 and 1965. Five ships of the class have been decommissioned, starting in 2005 with USS *Duluth* (LPD 6). The remaining seven ships are scheduled to be decommissioned by 2015 as the LPD 17 class ships are completed to replace them.

In terms of Seabasing capabilities, the *Austin*-class LPDs provide about a third of the cargo space, about two-thirds of the vehicle space, and about half the troop complement of an LHD. They have only limited surface connector capacity (only one LCAC can be carried) and can only support a very limited number of helicopters from the flight deck. Table 5 summarizes how much capability the *Austin*-class has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *Austin*-class has a composite Seabasing Utility score of six points.

Metric	LPD 4 Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	51,000	560,000	Cubic feet	1
Vehicles	14,000	300,000	Square feet	0
Troops	885	12,700	Personnel	1
Aircraft	4	260	"CH-46 equivalent" spots	0
Surface Connectors	1	31	"LCAC equivalent" spots	0
Speed	21	20	Knots	4

Table 5 – LPD 4 Seabasing Utility<sup>61</sup>

<sup>61</sup> *Amphibious Ships and Landing Craft Data Book*, 9-11.

The utility provided by the *Austin*-class to the Joint Force outside of Seabasing is essentially identical to that provided by the larger amphibious ships, although its capacity is somewhat smaller all around. Therefore, the LPD 4 is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LPD 4 has a composite Joint Utility score of twenty-eight points.

As the LPD 4 is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the LPD 4 is awarded fifty points for Development Status.

The unit cost of the LPD 4 is \$1,848 million.<sup>62</sup> Since one LPD is required as a component of the MEB Seabasing force, the total cost to field is also \$1,848 million. This results in a Cost to Field score of thirty points.

#### *San Antonio-class (LPD 17)*

The *San Antonio*-class LPD was designed as a replacement for the LPD 4 class to supplement the LHDs and LSDs in an ESG. As an essentially new design, the LPD 17 was designed from the beginning to support all next-generation Marine Corps equipment, including the ability to operate and hanger-stow the MV-22. The LPD 17 provides a significant improvement over the LPD 4 class in terms of capacity for vehicles and landing craft, at the cost of some cargo space, as well as significantly improved command

---

<sup>62</sup> Unit cost of the LPD 4 class is listed as \$235-\$419 million in U.S. Department of Defense, Department of the Navy, *US Navy Fact File: Amphibious Transport Dock – LPD* (Washington, D.C. 2006) accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=600&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=600&ct=4) on 25 February 2007. Assuming that these are then-year costs for the ships, taking the upper value of \$419 million FY65 dollars converts to \$2,202 million FY07 dollars and taking the lower value of \$235 million FY61 dollars converts to \$1,393 million FY07 dollars. Averaging the two extremes gives an estimated cost of \$1,848 million.

and control capabilities. The first ship of the class, USS *San Antonio* (LPD 17) was commissioned in 2006, and the remaining eight ships of the class are expected to be completed at the rate of about one ship per year. The class was originally to be a total of twelve ships, but the current plan is only for nine. The remaining three may be procured at some point in the future.

In terms of Seabasing capabilities, the *San Antonio*-class LPDs provide their most significant contribution in their vehicle capacity, which is about as large as an LHD provides, and its well deck space, capable of carrying two LCACs. It also provides some cargo and troop capacity, and a limited amount of aviation support. Table 6 summarizes how much capability the *San Antonio*-class has compared to each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *San Antonio*-class has a composite Seabasing Utility score of eight points.

Metric	LPD 17 Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	35,000	560,000	Cubic feet	1
Vehicles	25,000	300,000	Square feet	1
Troops	667	12,700	Personnel	1
Aircraft	4	260	"CH-46 equivalent" spots	0
Surface Connectors	2	31	"LCAC equivalent" spots	1
Speed	22	20	Knots	4

**Table 6 – LPD 17 Seabasing Utility<sup>63</sup>**

<sup>63</sup> *Amphibious Ships and Landing Craft Data Book*, 12-14.

The utility provided by the *San Antonio*-class to the Joint Force outside of Seabasing is essentially identical to that provided by other amphibious ships. Therefore, the LPD 17 is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LPD 17 has a composite Joint Utility score of twenty-eight points.

As the LPD 17 is a platform that is currently under construction, with one ship fully in commission, no developmental effort is required to incorporate it into Seabasing. Thus, the LPD 17 is awarded fifty points for Development Status.

The expected average unit cost of the LPD 17 program is \$1,423.9 million.<sup>64</sup> Since only one LPD is required as part of the MEB Seabasing force, the total cost to field is also \$1,423.9 million. This results in a Cost to Field score of thirty points.

#### *Whidbey Island-class (LSD 41)*

The *Whidbey Island*-class LSD is, like the *Austin*-class, an evolution of World War II-era amphibious ship design. The LSD 41 was the first ship specifically designed to carry the LCAC, and can support a larger number of LCACs than any other ship in the fleet. Similar in general layout to the LPD 4, the LSD 41 has a large well deck that is covered by a flight deck. The LSD 41 can operate helicopters for the flight deck, but has no hanger space and no support facilities for aircraft. The eight ships of the class were commissioned between 1985 and 1992, and are expected to remain in service through about 2020.

---

<sup>64</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion, Navy*, p. 17-1.

In terms of Seabasing capabilities, the *Whidbey Island*-class LSDs provide their most significant contribution in their surface connector capacity, which is even more than is provided by an LHD. It also provides some vehicle and troop capacity, with a very limited amount of cargo capacity and aviation support. Table 7 summarizes how much capability the *Whidbey Island*-class has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *Whidbey Island*-class has a composite Seabasing Utility score of five points.

Metric	LSD 41 Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	8,970	560,000	Cubic feet	0
Vehicles	11,831	300,000	Square feet	0
Troops	504	12,700	Personnel	0
Aircraft	0	260	"CH-46 equivalent" spots	0
Surface Connectors	2	31	"LCAC equivalent" spots	1
Speed	22	20	Knots	4

**Table 7 – LSD 41 Seabasing Utility<sup>65</sup>**

The utility provided by the *Whidbey Island*-class to the Joint Force outside of Seabasing is essentially identical to that provided by other amphibious ships. Therefore, the LSD 41 is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LSD 41 has a composite Joint Utility score of twenty-eight points.

<sup>65</sup> *Amphibious Ships and Landing Craft Data Book*, 18-20.



As the LSD 41 is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the LSD 41 is awarded fifty points for Development Status.

The unit cost of the LSD 41 program was \$765.5 million.<sup>66</sup> Since only one LSD is required as part of the MEB Seabasing force, the total cost to field is also \$765.5 million. This results in a Cost to Field score of forty points.

#### *Harpers Ferry-class (LSD 49)*

The *Harpers Ferry*-class LSD is a modified version of the *Whidbey Island*-class. The LSD 41 design was modified to greatly increase the available cargo and vehicle space at the cost of cutting the well deck capacity in half. Essentially identical to the LSD 41 from the outside, the LSD 49 also has a large well deck and a flight deck, but no hanger. The eight ships of the class were commissioned between 1994 and 1998, and are expected to remain in service through the 2020s.

In terms of Seabasing capabilities, the *Harpers Ferry*-class LSDs provide their most significant contribution in their cargo and vehicle capacity. The cargo capacity is just under half that provided by an LHD, and it provides about four-fifths of the vehicle capacity of an LHD. The LSD 49 also provides some troop and surface connector capacity, with a very limited amount of aviation support. Table 8 summarizes how much capability the *Harpers Ferry*-class has compared to each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the *Harpers Ferry*-class has a composite Seabasing Utility score of seven points.

---

<sup>66</sup> Cost of LSD 41 was given at \$416.2 million in FY82 dollars. U.S. General Accounting Office, *Status of Major Acquisitions as of September 30, 1982* (Washington, D.C., 1983), 99.

Metric	LSD 49 Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	67,600	560,000	Cubic feet	1
Vehicles	20,200	300,000	Square feet	1
Troops	508	12,700	Personnel	0
Aircraft	0	260	“CH-46 equivalent” spots	0
Surface Connectors	2	31	“LCAC equivalent” spots	1
Speed	22	20	Knots	4

**Table 8 – LSD 49 Seabasing Utility<sup>67</sup>**

The utility provided by the *Harpers Ferry*-class to the Joint Force outside of Seabasing is essentially identical to that provided by other amphibious ships. Therefore, the LSD 49 is awarded three points for HD/CS, ten points for Deterrence Operations, three points for MCO, three points for SSTR, six points for IW, and three points for Shaping Operations. Overall, the LSD 49 has a composite Joint Utility score of twenty-eight points.

As the LSD 49 is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the LSD 49 is awarded fifty points for Development Status.

The unit cost of the LSD 49 program was \$527.6 million.<sup>68</sup> Since only one LSD is required as part of the MEB Seabasing force, the total cost to field is also \$527.6 million. This results in a Cost to Field score of forty points.

<sup>67</sup> *Amphibious Ships and Landing Craft Data Book*, 21-23.

<sup>68</sup> Cost of LSD 49 was given as \$324.2 million in FY87 dollars in U.S. Department of Defense, Department of the Navy, *US Navy Fact File: Dock Landing Ship – LSD* (Washington, D.C. 2006) accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=1000&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1000&ct=4) on 25 February 2007.

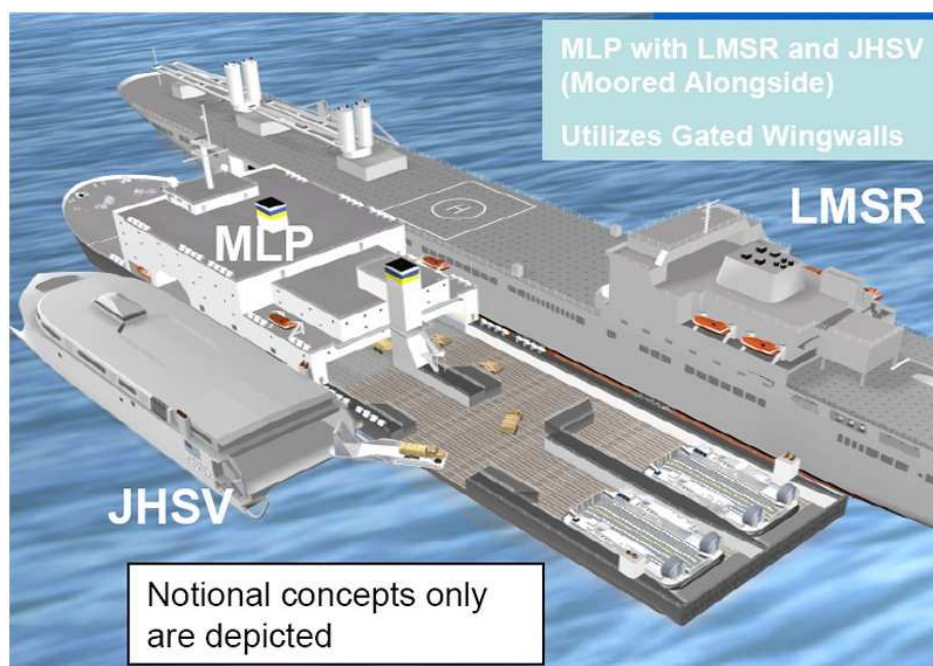
## *MLP*

The Mobile Landing Platform (MLP) is a staging platform concept that is designed to fill two major roles in the Seabasing concept. First, it would serve as a heavy lift ship, capable of bringing six LCACs (or equivalent surface connectors) to the Seabase from the ALSS. Once at the Seabase, the MLP would serve as a base of operations for those surface connectors, providing what is essentially a “beach” or open well deck equivalent where surface connector combat loading can be conducted. The MLP would mate up with one or more of the vehicle-carrying staging platforms. Vehicles would transfer from the vehicle carriers to the MLP by means of loading ramps and/or cranes to be loaded onto the surface connectors for further transfer ashore. Figure 4 depicts a notional concept drawing of what such an operation might look like. Acquisition of a total of three MLPs is projected, with one each in FY09, FY11, and FY13.<sup>69</sup>

In terms of Seabasing capabilities, the MLPs primary contribution is the surface connector capability it brings. Secondly, the MLP is expected to carry a certain amount of troops. The MLP is not expected to have any notable aviation, cargo, or vehicle capacity. Table 9 summarizes how much capability the MLP has compared to the each of the Seabasing metrics, as well as the class’s resulting Seabasing Utility score. Overall, the MLP has a composite Seabasing Utility score of seven points.

---

<sup>69</sup> U.S. Department of Defense, Department of the Navy, *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: National Defense Sealift Fund* (Washington, D.C., 2007), 16.



**Figure 4 – MLP, LMSR, and JHSV Concept Designs<sup>70</sup>**

Metric	MLP Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	0	560,000	Cubic feet	0
Vehicles	0	300,000	Square feet	0
Troops	900	12,700	Personnel	1
Aircraft	0	260	“CH-46 equivalent” spots	0
Surface Connectors	6	31	“LCAC equivalent” spots	2
Speed	20	20	Knots	4

**Table 9 – MLP Seabasing Utility<sup>71</sup>**

Unlike more traditional amphibious ships, the MLP only provides very limited capabilities to areas outside of Seabasing. The lack of helicopter capability severely

<sup>70</sup> “Mobile Landing Platform [MLP] Pictures” in *Globalsecurity.org* (Globalsecurity.org, updated 27 June 2006, 20:35 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/images/mlp-image02.jpg> on 25 February 2007.

<sup>71</sup> *NWP SEABASING*, p. A-11.

limits the MLP's usefulness as a staging platform for HD/CS, SSTR or IW. For HD/CS, Deterrence Operations, SSTR, IW, and Shaping, the MLP brings essentially no capabilities to the table that could be unique or relevant. The MLP does not present the effective contribution to Deterrence or Shaping Operations since a commercial-style vessel like this would not be perceived in the same way as a more conventional warship. Therefore, the MLP is thus awarded no points for these five JOCs. For MCO (outside of Seabasing), the MLP provides the capability to move small vessels to a theater from CONUS or another location. This capability is essentially identical to that provided by commercial heavy-lift semi-submersible vessels such as the MV *Mighty Servant II* or MV *Blue Marlin*. It also provides the ability to carry a small amount of troops, but this is a capability that is more effectively performed by traditional amphibious ships or airlift aircraft. Therefore, the MLP is awarded three points for the MCO JOC. Overall, the MLP has a composite Joint Utility score of three points.

Although the MLP is still a concept, the technologies required to produce such a vessel are mature and well-proven in both commercial and military applications. Commercial heavy-lift vessels could be considered "prototypes" of the MLP design. Thus, the MLP is awarded thirty points for Development Status.

The projected unit cost for the MLP is expected to be \$953.3 million each.<sup>72</sup> Since three MLPs are required to contribute to the MPF(F) portion of the MEB Seabasing force, the total cost to field is \$2,859.9 million. This results in a Cost to Field score of twenty points.

---

<sup>72</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: National Defense Sealift Fund*, 16.

*T-AKR LMSRs*

The T-AKR class of vessels are known as large, medium-speed, roll-on/roll-off (LMSR) ships. These ships are purpose-designed to carry vehicles, with essentially no capacity for any other type of cargo. The T-AKRs envisioned for the Seabasing concept are very similar to the most recent class of LMSRs built for the strategic sealift force, the *Bob Hope*-class (T-AKR 300) of vessels. A total of fifteen LMSRs were constructed between 1998 and 2002. Figure 4, above, shows a notional T-AKR design. Three Seabasing T-AKRs are planned under the current shipbuilding program, with one ship per year to be procured from FY10 to FY12.<sup>73</sup>

In terms of Seabasing capabilities, the T-AKR is exclusively a vehicle carrier. It excels in that role, providing enough vehicle capacity for an entire 2015 MEB. In practice, the T-AKR may carry fewer vehicles than its maximum, allowing for some space to conduct selective offload. The ship has a helicopter landing platform, but does not have any aviation support facilities and would not be expected to support its own aircraft. The T-AKR has no innate capability for bulk cargo, although some of the vehicle space could be used to store trailer-loaded containers. Table 10 summarizes how much capability the T-AKR has compared to each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the T-AKR has a composite Seabasing Utility score of fourteen points.

---

<sup>73</sup> Ibid., 4.

Metric	T-AKR Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	0	560,000	Cubic feet	0
Vehicles	380,000	300,000	Square feet	10
Troops	0	12,700	Personnel	0
Aircraft	0	260	“CH-46 equivalent” spots	0
Surface Connectors	0	31	“LCAC equivalent” spots	0
Speed	20	20	Knots	4

**Table 10 – T-AKR Seabasing Utility<sup>74</sup>**

Similar to the MLP, the T-AKR only provides very limited capabilities to areas outside of Seabasing. For HD/CS, Deterrence Operations, SSTR, IW, and Shaping, the T-AKR brings essentially no capabilities to the table that could be unique or relevant. The T-AKR is thus awarded no points for these five JOCs. For MCO (outside of Seabasing), the T-AKR replicates the capabilities provided by LMSRs in the current Army and Marine Corps prepositioning forces, ready reserve fleet, and strategic sealift fleet as well as commercially available RO/RO ships. Therefore, the T-AKR is awarded three points for the MCO JOC. Overall, the T-AKR has a composite Joint Utility score of three points.

The Seabasing T-AKRs are essentially identical to currently in-service LMSRs. Thus, the T-AKR is awarded fifty points for Development Status.

<sup>74</sup> U.S. Department of Defense, Military Sealift Command, *Military Sealift Command – LMSR Fact Sheet* (Washington, D.C., 2007) accessed at <http://www.msc.navy.mil/factsheet/lmsr.asp> on 25 February 2007.

The projected unit cost for the T-AKR is expected to be \$1,024 million each.<sup>75</sup> Since three T-AKRs are required to contribute to the MPF(F) portion of the MEB Seabasing force, the total cost to field is \$3,072 million. This results in a Cost to Field score of twenty points.

### *T-AKE*

The T-AKE class is a cargo-focused vessel, initially designed to support operational fleet forces with food, ammunition, and repair parts via traditional underway replenishment (UNREP). The three T-AKEs envisioned for the Seabasing concept are a continuation of the current production of eleven *Lewis and Clark*-class (T-AKE 1) ships being procured for the Combat Logistics Force (CLF) to support carrier strike groups (CSGs) and other Battle Force ships. The first ship of the class, USS *Lewis and Clark* (T-AKE 1) was commissioned in 2006. A total of fourteen of these T-AKEs are to be procured, with one Seabasing-designated unit scheduled to be procured each year from FY09 to FY11.<sup>76</sup>

In terms of Seabasing capabilities, the T-AKE is intended to carry bulk cargo to provide sustainment for both Seabasing forces and forces ashore. Once the initial off-load of the T-AKE's supplies has been completed, the ship will convert to a "shuttle" role and return to the ALSS to pick up more sustainment supplies to bring back to the Seabase. The automate warehousing and selective offload capabilities that make the T-AKE useful as a support ship to the Battle Force also make it valuable in providing sustainment at the Seabase. The T-AKE does not have any capacity for troop, vehicle, or

---

<sup>75</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: National Defense Sealift Fund*, 4.

<sup>76</sup> *Ibid.*, 8.



surface connector transport. The ship has a helicopter landing platform, but does not have any aviation support facilities and would not be expected to support its own aircraft. Table 11 summarizes how much capability the T-AKE has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the T-AKE has a composite Seabasing Utility score of fourteen points.

Metric	T-AKE Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	1,108,592	560,000	Cubic feet	10
Vehicles	0	300,000	Square feet	0
Troops	0	12,700	Personnel	0
Aircraft	0	260	“CH-46 equivalent” spots	0
Surface Connectors	0	31	“LCAC equivalent” spots	0
Speed	20	20	Knots	4

**Table 11 – T-AKE Seabasing Utility<sup>77</sup>**

The T-AKE provides more capabilities to areas outside of Seabasing than other sealift-type ships, in that it is capable of providing needed sustainment to the Battle Force across the full range of military operations. This support is a significant improvement on the capabilities provided by the current CLF ships which the T-AKEs are replacing. Thus the T-AKE is awarded six points each for HD/CS, Deterrence Operations, MCO,

<sup>77</sup> “T-AKE Lewis and Clark Specifications” in *Globalsecurity.org* (Globalsecurity.org, updated 6 October 2006, 21:41 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/take-specs.htm> on 25 February 2007;

U.S. Department of Defense, Military Sealift Command, *Military Sealift Command – T-AKE Fact Sheet* (Washington, D.C., 2007) accessed at <http://www.msc.navy.mil/factsheet/t-ake.htm> on 25 February 2007.

SSTR, IW, and Shaping. Overall, this gives the T-AKE has a composite Joint Utility score of thirty-six points.

The Seabasing T-AKEs are essentially identical to the T-AKEs being procured for the CLF. Since one of these has been completed and is in service, T-AKE is awarded fifty points for Development Status.

The projected unit cost for the T-AKE is expected to be \$420.3 million each.<sup>78</sup> Since three T-AKEs are required to contribute to the MPF(F) portion of the MEB Seabasing force, the total cost to field is \$1,260.9 million. This results in a Cost to Field score of thirty points.

#### *Legacy T-AK*

The Legacy T-AK class consists of ships that are currently serving in the Maritime Prepositioning Force. The Seabasing concept calls for two of these ships to be incorporated into the MPF(F) squadron. Legacy T-AKs, also referred to as “dense pack” ships, have a portion of their space devoted to vehicle storage and a portion devoted to containerized cargo storage. The ships are equipped with a stern ramp for vehicle discharge and cranes for unloading cargo containers. Both of these systems are designed to be used pierside or at anchor in a calm harbor and are therefore not suitable for the types of cargo transfers envisioned in Seabasing without some sort of upgrade or modernization. Five of the specific class of Legacy T-AKs envisioned for the Seabasing concept were delivered in 1985 and 1986, and have been operated as leased vessels by the Military Sealift Command (MSC) since then.

---

<sup>78</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: National Defense Sealift Fund*, 8.

In terms of Seabasing capabilities, the Legacy T-AK is intended to carry containerized cargo and vehicles. The Legacy T-AK has a small troop capacity, intended to embark a small number of individuals while the ship was en route to the Seabase to prepare the equipment carried for operation. The Legacy T-AK does not have any capacity for surface connector transport. The ship has a helicopter landing platform that is certified to handle large helicopters (including the CH-53E), but does not have any aviation support facilities and would not be expected to support its own aircraft. Table 12 summarizes how much capability the Legacy T-AK has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the Legacy T-AK has a composite Seabasing Utility score of eighteen points.

Metric	Legacy T-AK Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	668,160	560,000	Cubic feet	10
Vehicles	162,500	300,000	Square feet	5
Troops	100	12,700	Personnel	0
Aircraft	0	260	"CH-46 equivalent" spots	0
Surface Connectors	0	31	"LCAC equivalent" spots	0
Speed	17.7	20	Knots	3

**Table 12 – Legacy T-AK Seabasing Utility<sup>79</sup>**

<sup>79</sup> Norman Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, 15<sup>th</sup> ed. (Annapolis, MD: Naval Institute Press, 1993), 289.

The utility provided by Legacy T-AK ships to areas outside of Seabasing is essentially identical to that provided by the T-AKR LMSRs. Therefore, the Legacy T-AK has a composite Joint Utility score of three points.

As the Legacy T-AKs are currently-existing ships, the Legacy T-AK is awarded fifty points for Development Status.

The estimated unit cost for the Legacy T-AK is \$484.6 million each.<sup>80</sup> Since two Legacy T-AKs are required to contribute to the MPF(F) portion of the MEB Seabasing force, the total cost to field is \$969.2 million. This results in a Cost to Field score of forty points.

#### *MPF 2010*

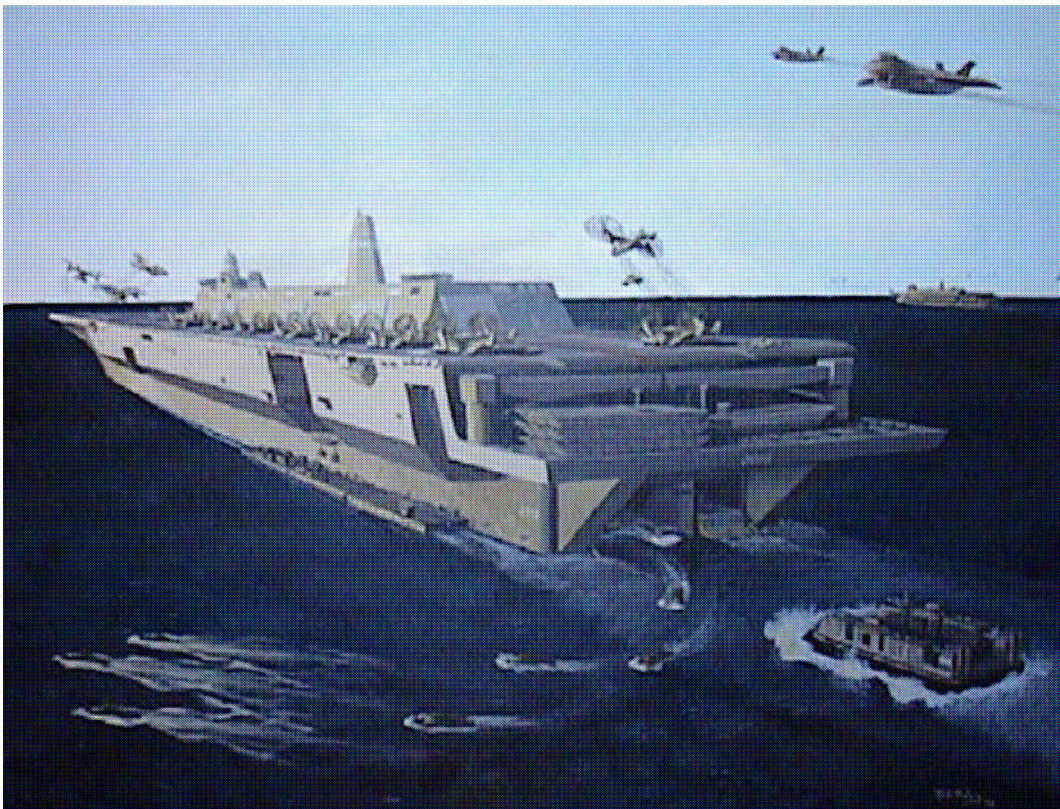
The MPF 2010 is a concept design that was created by a team in the Total Ship Systems Engineering program at Naval Postgraduate School.<sup>81</sup> The design is an evolution of the large-deck amphibious assault ship, with a well deck and full-length flight deck. It is capable of supporting the operations of all current Marine Corps rotary wing aircraft, the Joint Strike Fighter, LCACs, LCUs, and Marine Corps amphibious assault vehicles (AAAVs or EFVs). In the study's concept, five ships of the same design, operating together, would transport, insert, and support a MEB-sized force. A concept drawing of the design is shown in Figure 5.

---

<sup>80</sup> The combined cost for the thirteen MPS vessels leased by the Navy in the 1980's is estimated at \$5.1 billion FY00 dollars in U.S. General Accounting Office, *Historical Analysis of Navy Ship Leases* (Washington, D.C., 1999), 16. Converting this value to FY07 dollars and dividing by thirteen ships gives a unit cost of \$484.6 million.

<sup>81</sup> All data in this section is obtained from Charles N. Calvano et al., *The Maritime Prepositioning Force Ship 2010* (Monterey, CA: Naval Postgraduate School, Total Ships Systems Engineering Program, 1999).

In terms of Seabasing utility, the MPF 2010 provides a substantial amount of cargo, vehicle, troop, and aircraft space. The notable shortage in the design is the limited number of surface connector spots available. Table 13 summarizes how much capability the MPF 2010 has compared to the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score. Overall, the MPF 2010 has a composite Seabasing Utility score of twenty-four points.



**Figure 5 – MPF 2010 Concept Design**

Metric	MPF 2010 Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	1,166,400	560,000	Cubic feet	10
Vehicles	132,000	300,000	Square feet	4
Troops	3,884	12,700	Personnel	3
Aircraft	50 (estimated)	260	“CH-46 equivalent” spots	2
Surface Connectors	2	31	“LCAC equivalent” spots	1
Speed	25	20	Knots	4

**Table 13 – MPF 2010 Seabasing Utility**

The utility provided by MPF 2010 ships to areas outside of Seabasing is essentially identical to that provided by the large amphibious assault ships (LHD/LHA). Therefore, the MPF 2010 has a composite Joint Utility score of twenty-eight points.

As the MPF 2010 is only a conceptual design, it is awarded ten points for Development Status.

The estimated unit cost for the MPF 2010 is \$1,031.8 million each.<sup>82</sup> Since five MPF 2010-design ships called for in the design study to support a MEB Seabasing force, the total cost to field is \$5,159 million.<sup>83</sup> This results in a Cost to Field score of ten points.

<sup>82</sup> The cost of the MPF 2010 was estimated at \$816 million FY98 dollars. Ibid., 109.

<sup>83</sup> A force of five MPF 2010 ships would still leave a small shortfall in aircraft connector capability (10 spots) and a large one in surface connector capability (21 spots), driving this cost higher to either purchase enough MPF 2010s to fill the shortfalls or buying platforms of a different design to complement the MPF 2010s. The number of MPF 2010s called for in the design study is used here for simplicity.

### *Sea Force*

Similar to the MFP 2010, the Sea Force is also a concept design produced at Naval Postgraduate School in the Total Ship System Engineering Program.<sup>84</sup> This concept design is even more ambitious than the MPF 2010. The basic design is an 82,000 ton trimaran, capable of carrying approximately half of a MEU and of sustained speeds of twenty-five knots or greater. The design includes cutting-edge developmental combat capabilities, including unmanned underwater vehicles for anti-submarine and mine warfare, energy weapons for anti-missile defense, electromagnetic rail guns for anti-ship fires and naval gunfire support, electronic and acoustic countermeasures, and a phase-array radar system similar to the AEGIS system. The design incorporates a very large flight deck and is capable employing the full range of current and foreseeable rotary wing and VTOL aircraft. Substantial automation and robotics capabilities are included for warehousing, cargo movement, refueling, firefighting, aircraft handling, and ammunition handling. Maintenance capabilities equivalent to shore-based intermediate-level aviation and ship repair facilities are included, as well as a six hundred bed medical facility. Figure 6 shows a rendition of the Sea Force concept design.

In terms of Seabasing capabilities, the Sea Force has cargo capacity that is several times that of current large-deck amphibious assault ships, more vehicle and aircraft space than is found in all of a current-day ESG, and about the same number of troops as and LHD or LHA. The only notable weak spot in capabilities is in space available for surface connectors. Table 14 summarizes how much capability the Sea Force has compared to

---

<sup>84</sup> All data in this section is obtained from Charles N. Calvano et al., *SEA FORCE: A Sea Basing Platform* (Monterey, CA: Naval Postgraduate School, Total Ship Systems Engineering Program, 2003).

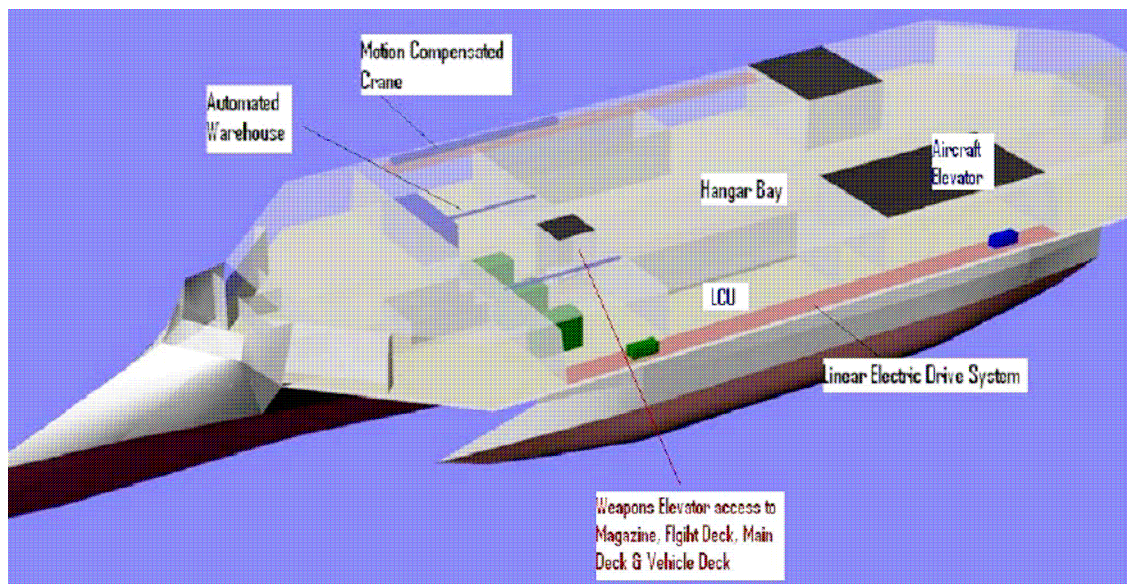


the each of the Seabasing metrics, as well as the class's resulting Seabasing Utility score.

Overall, the Sea Force has a composite Seabasing Utility score of twenty-two points.

Metric	Sea Force Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	960,000	560,000	Cubic feet	10
Vehicles	69,700	300,000	Square feet	2
Troops	~2,000	12,700	Personnel	2
Aircraft	~65	260	"CH-46 equivalent" spots	3
Surface Connectors	3	31	"LCAC equivalent" spots	1
Speed	25	20	Knots	4

**Table 14 – Sea Force Seabasing Utility**



**Figure 6 – Sea Force Concept Design Internal Arrangements**



The utility provided by Sea Force ships to areas outside of Seabasing is essentially identical to that provided by the large amphibious assault ships (LHD/LHA). Therefore, the Sea Force design has a composite Joint Utility score of twenty-eight points.

As the Sea Force is only a conceptual design, it is awarded ten points for Development Status. It is important to keep in mind that many of the technologies envisaged in this design, such as the energy weapons, rail guns, and robotic systems, are still very early in the developmental stages, and it may not be realistic to plan for a design to be built in the next ten years or so. The fundamental design is also questionable, in that a 82,000 ton, 990 foot long, 300 foot wide ship like the Sea Force is outside of current technologies. The largest trimaran design that has been built to date is only 2,000 tons. It would also be problematic to find a shipyard large enough in which to construct such an out-sized vessel, as it would require a larger drydock than an aircraft carrier.

The estimated unit cost for the Sea Force is an astounding \$3,963 million each.<sup>85</sup> Since six Sea Force-design ships are required for the MEB Seabasing force, the total cost to field is over \$23.8 *billion*.<sup>86</sup> This results in a Cost to Field score of zero points.

### *Maersk S-Class Conversion*

Another concept design for a Seabasing platform is one proposed in a 2005 Naval Research Advisory Council Report.<sup>87</sup> This design concept, conducted under a

---

<sup>85</sup> The cost of the Sea Force estimated in the design study was \$3,541 million FY02 dollars. Ibid., 269.

<sup>86</sup> Similar to the MPF 2010s, a force of six Sea Force ships would still leave a shortfall of 13 spots in surface connector capability, driving this cost even higher to either purchase enough Sea Force ships to fill the shortfall or platforms of a different design to complement the Sea Force ships. The number of Sea Force ships called for in the design study is used here for simplicity.

<sup>87</sup> All data in this section is obtained from U.S. Department of Defense, Naval Research Advisory Committee, *Sea Basing* (Washington, D.C., 2005), 51-61.

MSC/USTRANSCOM program, is for the conversion of an existing commercial container ship into a Seabasing staging platform. The base ship for the design is 1,145 foot long S-class container ship operated by the Danish shipping company Maersk Lines. The conversion would focus on aviation capabilities and troop transport. Unlike the MPF 2010 or Sea Force, the S-class conversion would be designed to commercial, not military, standards.



**Figure 7 – Maersk S-Class Conversion Concept Design**

The S-class conversion design, depicted in Figure 7, has a large flight and hanger deck, with the ability to carry 72 “CH-46 equivalents” in the hanger deck and operate fifteen more from the flight deck. It would be capable of operating all current and near-future rotary wing aircraft, but JSF capability would not be included. With significant modular berthing facilities, the S-class conversion would carry almost half of a MEB’s

personnel. Automated warehousing techniques and equipment would be used for bulk cargo storage and retrieval. A unique feature of this design is the surface connector interface. The design would include a transverse “tunnel” through the sides of the ship. The doors of this tunnel would lower to serve as ramps and an air cushion connector like an LCAC would drive into the ship to be loaded by cranes from above. Interestingly, the design does not include any provision for vehicle or surface connector storage. Such storage would, therefore, have to be provided for by other elements of the Seabasing force. Table 15 summarizes how much capability the S-class conversion has compared to the each of the Seabasing metrics, as well as the class’s resulting Seabasing Utility score. Overall, the S-class conversion has a composite Seabasing Utility score of sixteen points.

Metric	S-Class Conversion Capability	MEB Requirement	Units	Seabasing Utility Score
Cargo	230,400	560,000	Cubic feet	4
Vehicles	0	300,000	Square feet	0
Troops	6,000	12,700	Personnel	5
Aircraft	87	260	“CH-46 equivalent” spots	3
Surface Connectors	1	31	“LCAC equivalent” spots	0
Speed	25	20	Knots	4

**Table 15 – S-Class Conversion Seabasing Utility**

The S-class conversion provides more capabilities to areas outside of Seabasing than other commercial-style staging platforms, but not quite as much as a traditional amphibious ship. For HD/CS, MCO, and SSSTR, this design would provide the same capabilities as an LHD/LHA type of vessel. The design is therefore awarded three points

each for HD/CS, MCO, and SSTR. The one area that it would provide an enhanced contribution to over and above a traditional amphibious ship would be in IW. In this case, in addition to providing a sovereign Afloat Forward Staging Base, the commercial character of the S-class conversion would make it less provocative than a grey-hulled warship. Therefore, the design is awarded ten points for IW. It would not provide an effective contribution to Deterrence or Shaping Operations since a commercial-style vessel like this would not be perceived in the same way as a more conventional warship. The S-class conversion is therefore not awarded any points for contributions to Deterrence or Shaping Operations. Overall, the S-class conversion has a composite Joint Utility score of nineteen points.

In terms of developmental status, the S-class conversion is based on a currently-operating ship design, but involves some developmental technologies in terms of cargo handling and surface connector interfaces. None of this technology, however, is beyond current feasibility. It is therefore awarded a Developmental Status score of thirty points.

An important advantage of the S-class conversion concept is its relatively low cost. The estimated unit cost to purchase and convert an S-class ship is \$322.6 million each.<sup>88</sup> A MEB Seabasing force would probably require at least three S-class conversion ships, giving a total cost to field of \$967.8 million.<sup>89</sup> This results in a Cost to Field score of forty points.

---

<sup>88</sup> The cost of the S-class conversion was estimated at \$300 million FY05 dollars. Ibid., 61.

<sup>89</sup> Three S-class conversions could carry all the troops, aircraft, and cargo for a MEB, roughly filling the role of the two LHA(R)s in the MPF(F) construct. This would still require supplemental platforms such as T-AKR and MLPs to carry the MEB's vehicle and surface connectors. Adding one T-AKR and five MLPs to meet this requirement would add about \$5,791 million to the total cost to field for a full capability package.

## Key Capability Area #2 – Aircraft Connectors

Connectors are crucial to the Seabasing concept in that they provide the means to move personnel, equipment, and supplies to the Seabase from rear areas, within the Seabase, and from the Seabase to the objective areas ashore. Unlike the staging platforms, there is a much greater diversity of technologies in potential connector solutions. Some of these are small surface craft, some are large aircraft, and several are hybrid craft that blur the boundaries between ships and aircraft. All of these potential solutions share the common capabilities of significantly higher speeds and smaller payload capabilities than the staging platforms. The eleven potential aircraft connector solutions that will be evaluated in this section all fill the tactical Seabase-to-objective role. Although it is possible that some of these solutions can fill an ALSS-to-Seabase role, particularly with in-flight refueling, this role is not considered in this section due to the long range from the ALSS to the Seabase relative to the operational ranges of the various solutions. Large, long-range fixed wing aircraft will not be discussed. This is due to the fact that there is no technologically workable combination of staging platform and large fixed wing cargo aircraft in the foreseeable future. As with the staging platforms, a fully-formed Seabasing capability will include several of these potential solutions. Surface connectors will be evaluated in the next section.

### *CH-46*

The twin-rotor CH-46 is the current Marine Corps medium-lift troop transport and cargo helicopter. It has filled roles in both ship-to-ship cargo transfer (vertical replenishment, or VERTREP) and ship-to-shore cargo and troop transfer since its

introduction in the mid 1960s. The CH-46 was retired from Navy service in 2004 but is expected to remain in Marine Corps service through about 2014, being gradually replaced by the MV-22.

In terms of Seabasing utility, the CH-46 provides limited capabilities. Table 16 depicts the CH-46's range, speed, and cargo capacity in comparison to the Seabasing requirements. Of note, the cargo capacity shown is for external loads. The CH-46's internal load cargo capacity is significantly smaller at 1,700 lbs. The operational range and speed are the same for either external or internal loading, so the larger external capacity is used. As a helicopter, it is awarded an additional ten points for VTOL capability. The CH-46 is not capable of in-flight refueling. Overall, the CH-46 has an overall Seabasing Utility score of twenty points.

Metric	CH-46 Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	4,000	40,000	Lbs	1
Speed	110	217	knots	5
Range	75	200	Nm	4

**Table 16 – CH-46 Seabasing Utility<sup>90</sup>**

The CH-46 provides some capabilities to areas outside of Seabasing. For each of the JOCs outside of Seabasing, it provides the enabling capability of airborne cargo and personnel transport, similar to other military cargo helicopters. Since this is a relatively common capability, resident in several platforms in the inventory, and the CH-46 does not provide any significantly unique capability in these areas, three points each are

<sup>90</sup> U.S. General Accounting Office, *Improving Amphibious Capability Would Require Larger Share of Budget Than Previously Provided* (Washington, D.C., 1996), 32.

awarded for each of the JOCs. Overall, the CH-46 has a composite Joint Utility score of eighteen points.

As the CH-46 is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the CH-46 is awarded fifty points for Development Status.

CH-46s were built in the late 1960s for a cost of \$10.2 million each.<sup>91</sup> To determine the number of CH-46s required to support a brigade ashore, some assumptions need to be made. As was discussed above, the total daily logistics requirement of a MEB-sized force ashore is up to 95 tons of provisions, 688 tons of ammunition, and 1595 tons of fuel per day; for a total of 2,378 tons. Each CH-46 could conduct a round trip to the limit of its range (75 nm) in about 2.4 hours (at 110 knots, with 30 minutes on each end allotted for loading/unloading) carrying two tons (4,000 lbs). Assuming 24-hour operations and that each helicopter would be available for eighty percent of the time, about 147 CH-46s would be required to carry all of a brigade's sustainment.<sup>92</sup> Therefore, the total cost to field is \$1,499.4 million. This results in a Cost to Field score of thirty points.

### *CH-53E*

The CH-53 was first introduced in the late 1960s as a Navy and Marine Corps heavy lift helicopter. The CH-53E, first entering service in 1981, is most recent variant

---

<sup>91</sup> 25 CH-46s were to be procured in FY69 for about \$50 million, which converts to an FY07 price of \$10.2 million each. Robert McNamara to Lyndon Johnson, "Defense Department Budget for FY 69" [draft memorandum], 1 December 1967, U.S. Department of State, Office of the Historian, Foreign Relations, 1964-1968, Vol. X, National Security Policy, Document #195, accessed at <http://www.state.gov/r/pa/ho/frus/johnsonlb/x/9100.htm> on 6 March 2007.

<sup>92</sup> The method for calculating the of number of aircraft required is detailed in Appendix 2.

of the design and the Marine Corps' current heavy-lift troop transport and cargo helicopter. The CH-53E is primarily used for ship-to-shore cargo and troop transfer.

In terms of Seabasing utility, the CH-53E provides capabilities that are greater than those of the CH-46, but not up to the full Seabasing requirements. Table 17 depicts the CH-53E's range, speed, and cargo capacity in comparison to the Seabasing requirements. The aircraft is capable of both longer range with a smaller payload (up to 540 nm without refueling), and a somewhat larger load (up to 37,000 lbs) at a reduced range. The load/range combination used here is that given as the design capability. As a helicopter, the CH-53E is awarded an additional ten points for VTOL capability. It is capable of in-flight refueling, and is awarded ten points for this capability. This would allow an extension to the operational range of the CH-53E, but at the cost of requiring dedicated tanker support. Overall, the CH-53E has a Seabasing Utility score of thirty-eight points.

Metric	CH-53E Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	32,000	40,000	lbs	8
Speed	150	217	knots	7
Range	50	200	nm	3

**Table 17 – CH-53E Seabasing Utility<sup>93</sup>**

<sup>93</sup> U.S. Department of Defense, U.S. Marine Corps, *HQMC Fact Files: CH-53E Super Stallion Helicopter* (Washington, D.C., 1995) accessed at <http://www.hqmc.usmc.mil/factfile.nsf/7e931335d515626a8525628100676e0c/8a583a9bef2c6f8d8525626e0048f5fc?OpenDocument> on 4 March 2007.



The CH-53E provides capability to areas outside of Seabasing similar to that provided by the CH-46. As the CH-53E has the highest payload capacity of any VTOL cargo aircraft in the current inventory, the CH-53E is awarded six points for each of the JOCs. Overall, the CH-53E has a composite Joint Utility score of thirty-six points.

As the CH-53E is a currently-fielded platform, no developmental effort is required to incorporate it into Seabasing. Thus, the CH-53E is awarded fifty points for Development Status.

The CH-53Es in the inventory were built in the early 1980s for a cost of \$32 million each.<sup>94</sup> Using the same assumptions as were used for the CH-46 calculation, each CH-53E could conduct a round trip to the limit of its range (50 nm) in about 1.7 hours (at 150 knots, with 30 minutes on each end allotted for loading/unloading) carrying a load of 32,000 lbs. Assuming 24-hour operations and that each helicopter would be available for eighty percent of the time, about thirteen CH-53Es would be required to carry all of a brigade's sustainment. Therefore, the total cost to field is \$416 million. This results in a Cost to Field score of fifty points.

## *MV-22*

The MV-22 Osprey is the first production tilt-rotor aircraft to be employed by the US military. The Osprey has had a long and troubled development process, with costs and timelines far exceeding what had been expected when the program was launched. The Marine Corps is in the process of replacing its aging CH-46 fleet with MV-22s, with

---

<sup>94</sup> FY07 dollars. Replacement cost was given as \$26.1 million FY95 dollars each. Ibid.

the first squadron reaching operational capability in March 2006.<sup>95</sup> The aircraft is intended primarily to fill the ship-to-shore troop and cargo transport roles of the CH-46, while providing additional reach for ship-based forces.

The significant Seabasing advantages that the MV-22 offers over the current generation of helicopters are speed and range. Table 18 depicts the MV-22's range, speed, and cargo capacity in comparison to the Seabasing requirements. The aircraft is capable of both longer range with a smaller payload (upwards of 500 nm without refueling), and a somewhat larger load (up to 20,000 lbs) at very short ranges. The load/range combination used here is the capability that the MV-22 provides at the 200 nm Seabasing target range. The MV-22 is a tilt-rotor aircraft, so it is awarded ten points for its VTOL capability. The MV-22 is capable of in-flight refueling, and is awarded ten points for this capability as well. This would allow an extension to the operational range of the MV-22, but at the cost of requiring dedicated tanker support. Overall, the MV-22 has a Seabasing Utility score of forty-four points.

Metric	MV-22 Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	17,000	40,000	lbs	4
Speed	240	217	knots	10
Range	200	200	nm	10

**Table 18 – MV-22 Seabasing Utility<sup>96</sup>**

<sup>95</sup> Samuel D. White, "VMM-263 Ready to Write Next Chapter in Osprey Program," *Marine Corps News*, 7 March 2006, accessed at <http://www.marines.mil/marinelink/mcn2000.nsf/0/217128503734FF2B8525712A004D67BC?opendocument> on 4 March 2007.

<sup>96</sup> "V-22 Osprey Specifications" in *Globalsecurity.org* (Globalsecurity.org, updated 8 February 2006, 18:33 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/aircraft/v-22-specs.htm> on 4 March 2007.

The MV-22 provides capability to areas outside of Seabasing similar to that provided by other cargo helicopters. Because the MV-22 combines the significant advantages in range and speed similar to fixed-wing cargo aircraft, with the operational flexibility of traditional helicopters, it is awarded six points for each of the JOCs. Overall, this gives the MV-22 a composite Joint Utility score of thirty-six points.

Although still very new, the MV-22 is a currently-fielded platform, and requires no further developmental effort to incorporate it into Seabasing. Thus, the MV-22 is awarded fifty points for Development Status.

The MV-22 is currently in procurement, with a current estimated average cost of \$81.3 million each.<sup>97</sup> Using the same assumptions as above, each MV-22 could conduct a round trip to the desired Seabasing range (200 nm) in about 2.7 hours (at 240 knots, with 30 minutes on each end allotted for loading/unloading) carrying a load of 17,000 lbs. Assuming 24-hour operations and that each aircraft would be available for eighty percent of the time, about thirty-nine MV-22s would be required to carry all of a brigade's sustainment. Therefore, the total cost to field is \$3,170.7 million. This results in a Cost to Field score of twenty points.

### *CH-53K*

The CH-53K is an evolution of the current CH-53E design, intended to improve upon the CH-53E's range and cargo capacity to support future Marine Corps requirements for Seabasing by integrating more powerful engines and advanced

---

<sup>97</sup> FY07 dollars. Based on FY07 Budget estimate for average unit cost over total program in U.S. Department of Defense, Department of the Navy, *Fiscal Year (FY) 2007 Budget Estimates Submission Justification of Estimates: Aircraft Procurement, Navy, Vol I: Budget Activities 1-4* (Washington, D.C., 2006), exhibit P-40, p. 1.

technologies for airframe and rotor construction. The impetus behind the CH-53K program (also known as the Heavy Lift Replacement/HLR or CH-53(X) program) is to provide a near-term, low-risk replacement for the rapidly-aging CH-53E fleet as it begins to reach end-of-life between 2011 and 2013.<sup>98</sup> It is anticipated that the first prototype CH-53K will fly sometime in 2011, with an initial operational capability around 2015.<sup>99</sup>

The significant Seabasing improvements offered by the CH-53K over the CH-53E is payload capability at range. It is anticipated that a small increase in speed is also likely. Table 19 depicts the projected CH-53K capabilities in range, speed, and cargo capacity in comparison to the Seabasing requirements. The load/range combination used here is that given as the design capability. Like its predecessor, the CH-53K is capable of both VTOL and in-flight refueling, and is awarded ten points for each of these capabilities. Overall, the CH-53K has a Seabasing Utility score of forty-one points.

Metric	CH-53K Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	27,000	40,000	lbs	7
Speed	170	217	knots	8
Range	110	200	nm	6

**Table 19 – CH-53K Seabasing Utility<sup>100</sup>**

The CH-53K provides useful capabilities to other JOCs, with improvements in range and speed, but these capabilities are similar to those provided by current platforms

<sup>98</sup> Liles and Bolkcom, *Military Helicopter Modernization: Background and Issues for Congress*, 23.

<sup>99</sup> “CH-53K Super Stallion Heavy Lift Replacement”, in *Globalsecurity.org* (Globalsecurity.org, updated 30 September 2006, 16:01 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/aircraft/ch-53k.htm> on 4 March 2007.

<sup>100</sup> Sikorsky, *Sikorsky CH-53K Helicopter* brochure (Stratford, CT: Sikorsky, 2006), 2.

such as the CH-53E. Therefore, it is awarded six points for each of the JOCs. Overall, this gives the CH-53K a composite Joint Utility score of thirty-six points.

The CH-53K is still early in the development stages, although the technologies required are relatively low-risk. Therefore, the CH-53K is awarded twenty points for Development Status.

The estimated unit fly-away cost for the CH-53K is about \$47.6 million each.<sup>101</sup> Using the same assumptions as above, each CH-53K could conduct a round trip to its maximum operational range (110 nm) in about 2.3 hours (at 170 knots, with 30 minutes on each end allotted for loading/unloading) carrying a load of 27,000 lbs. Assuming 24-hour operations and that each aircraft would be available for eighty percent of the time, about twenty-two CH-53Ks would be required to carry all of a brigade's sustainment. Therefore, the total cost to field is \$1,047.2 million. This results in a Cost to Field score of thirty points.

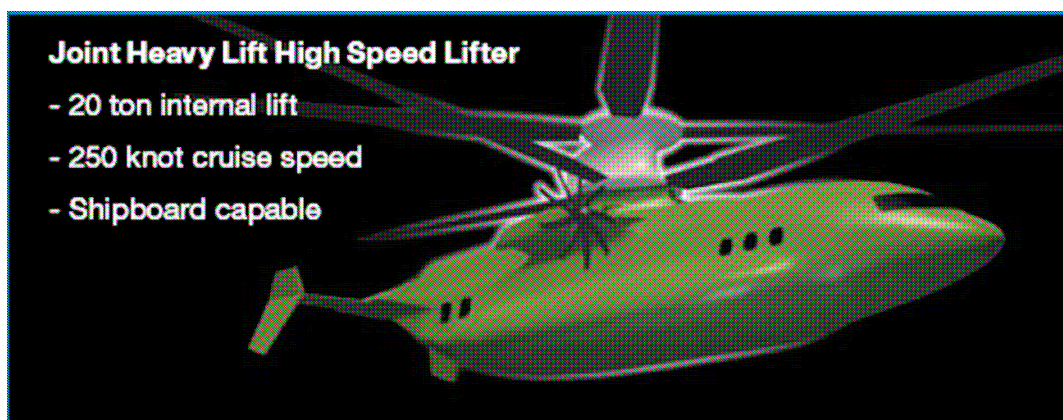
### *Sikorsky X2HSL*

The Sikorsky X2HSL is a conceptual design for a heavy-lift helicopter that has been proposed as part of the Joint Heavy Lift (JHL) development program. The design, depicted in Figure 8, hinges around a coaxial rotor configuration similar to Russian helicopters such as the Kamov Ka-27 Helix, with the addition of propellers to add to the design's maximum speed. The design goals for the X2HSL are to meet the requirements

---

<sup>101</sup> FY07 dollars. Based on \$45 million FY05 dollar estimate. Gordon IV et al., *Assessment of Navy Heavy-Lift Aircraft Options*, 50.

of the US Army “to maneuver an FCS/Stryker/LAV Vehicle over a 250 nautical mile (nm) radius...from/to land or sea bases and operating areas.”<sup>102</sup>



**Figure 8 – Sikorsky X2HSL Concept Design**

The Seabasing capability goals for the X2HSL design are depicted in Table 20. Of note, an aircraft such as the X2HSL that meets the JHL specifications would also meet the Seabasing requirements for speed, range and cargo capacity. The design is, obviously, VTOL, but it does not appear to include an in-flight refueling capability. Assuming that the actual design could meet its stated goals, the X2HSL has a Seabasing Utility score of forty points.

The X2HSL provides improvements to current heavy lift helicopters in areas outside of Seabasing. Therefore, it is awarded six points for each of the JOCs. Overall, this gives the X2HSL a composite Joint Utility score of thirty-six points.

<sup>102</sup> “CH-53X HLR & JHL: Future Heli Programs on Collision Course?”, *Defense Industry Daily*, 27 September 2005, accessed at <http://www.defenseindustrydaily.com/2005/09/ch53x-hlr-jhl-future-heli-programs-on-collision-course/index.php> on 4 March 2007.

Metric	Sikorsky X2HSL Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	40,000	40,000	lbs	10
Speed	250	217	knots	10
Range	250	200	nm	10

**Table 20 – Sikorsky X2HSL Seabasing Utility<sup>103</sup>**

The X2HSL is still early in the development stages, and the technologies required to produce a craft that meets all of the requirements face significantly technological risk. Therefore, the X2HSL is awarded ten points for Development Status.

The estimated unit fly-away costs for the X2HSL are somewhere in the neighborhood of \$100 million each.<sup>104</sup> Using the same assumptions as above, each X2HSL could conduct a round trip to the desired Seabasing range (200 nm) in about 2.6 hours (at 250 knots, with 30 minutes on each end allotted for loading/unloading) carrying a load of 40,000 lbs. Assuming 24-hour operations and that each aircraft would be available for eighty percent of the time, about seventeen X2HSLs would be required to carry all of a brigade's sustainment. Therefore, the total cost to field is \$1,700 million. This results in a Cost to Field score of thirty points.

#### *V-44 Quad Tilt-Rotor*

Another concept design in the HSL competition, the V-44 quad tilt-rotor (QTR) is an evolution of the V-22 Osprey design, with four engines on two wings and a fuselage

<sup>103</sup> Sikorsky, *X2 Technology* brochure (Stratford, CT: Sikorsky, 2006), 2.

<sup>104</sup> John Grossman et al., *Vertical Envelopment and the Future Transport Rotorcraft: Operational Considerations for the Objective Force* (Santa Monica, CA: RAND, 2003), 18.

the size of a C-130. Like the X2HSL, the V-44 design would be scoped to meet the HSL requirements for cargo capacity and range.



**Figure 9 – V-44 Quad Tilt-Rotor Concept Design**

The Seabasing capability goals for the V-44 design are depicted in Table 21. Of note, an aircraft such as the V-44 that meets the JHL specifications would also meet the Seabasing requirements for speed, range and cargo capacity. As with the X2HSL, the design is VTOL, but unlike the X2HSL it appears to include an in-flight refueling capability. Assuming that the actual design could meet its stated goals, the V-44 has a Seabasing Utility score of fifty points.

The V-44 provides improvements to current heavy lift helicopters in areas outside of Seabasing. Therefore, it is awarded six points for each of the JOCs. Overall, this gives the V-44 a composite Joint Utility score of thirty-six points.



Metric	V-44 QTR Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	40,000	40,000	lbs	10
Speed	250	217	knots	10
Range	500	200	nm	10

**Table 21 – V-44 QTR Seabasing Utility<sup>105</sup>**

The V-44 is still early in the development stages and, as with the X2HSL, the technologies required to produce a craft that meets all of the requirements face significant developmental risk. Therefore, the V-44 is awarded ten points for Development Status.

The estimated unit fly-away costs for the V-44 are somewhere in the neighborhood of \$100 million each.<sup>106</sup> As it has the same design characteristics as the X2HSL, about seventeen V-44s to carry all of a brigade's sustainment. Therefore, the total cost to field is also about \$1,700 million. This results in a Cost to Field score of thirty points.

### Key Capability Area #3 – Surface Connectors

Similar to aircraft connectors, surface connectors fill a crucial role in the Seabasing concept by providing another means to move personnel, equipment, and supplies to the Seabase from rear areas, within the Seabase, and from the Seabase to the objective areas ashore. Although limited to close-to-the-shoreline objective areas, surface connectors provide a capability to carry heavier loads (e.g. heavy armored

<sup>105</sup> "Quad Tilt-Rotor" in *Globalsecurity.org* (Globalsecurity.org, updated 22 September 2005, 18:38 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/aircraft/qtr.htm> on 4 March 2007.

<sup>106</sup> John Grossman et al., *Vertical Envelopment and the Future Transport Rotorcraft*, 18.

vehicles) that aircraft connectors are simply unable to lift. Most of the surface connectors fall into one of two categories, either the tactical Seabase-to-objective role or the ALSS-to-Seabase role, although some could be used for both applications. All of these potential solutions share the common characteristics of being significantly slower than the aircraft connectors, but with larger payload capabilities, and significantly faster than the staging platforms, but with smaller payload capabilities. As with the staging platforms and aircraft connectors, a fully-formed Seabasing capability will include several of these potential solutions. Nine potential surface connector solutions will be evaluated in this section.

### *LCAC*

The current high-speed Seabase-to-objective surface connector in service is the Landing Craft, Air Cushion (LCAC). The LCAC is a hovercraft, capable of operating both over water and on land, and is compatible with the well decks of all current and planned amphibious ships. The LCAC is not capable of long-range self-deployment, and must be carried to the Seabase on another vessel. Developed in the 1980s, the LCAC was first deployed in 1987. The LCAC fleet is currently undergoing a Service Life Extension Program (SLEP) that will add ten years to the useful life of each craft. Even with this extension, the useful life of the fleet will expire between 2014 and 2027.<sup>107</sup>

---

<sup>107</sup> "Landing Craft, Air Cushion (LCAC)" in *Globalsecurity.org* (Globalsecurity.org, updated 17 July 2006, 21:57 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/lcac.htm> on 4 March 2007;

U.S. Department of Defense, Department of the Navy, *US Navy Fact File – Landing Craft, Air Cushion*, (Washington, D.C., 2003), accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=1500&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1500&ct=4) on 4 March 2007.

The Seabasing capabilities of the LCAC are summarized in Table 22. As a hovercraft, the LCAC is fully amphibious, earning ten points for this capability. The LCAC therefore has a total Seabasing Utility score of twenty-five points.

Metric	LCAC Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	72	140	Tons	5
Speed	35	50	knots	7
Range	46	150	nm	3

**Table 22 – LCAC Seabasing Utility<sup>108</sup>**

The LCAC is essentially a single-purpose platform, and provides only very limited capabilities to areas outside of Seabasing. The one potential area in MCO outside of Seabasing that the LCAC could contribute to would be as a mine-hunting platform. In this way, it would provide an improved capability—less vulnerable than a traditional displacement craft mine hunter, but with more endurance and payload than a helicopter mine hunter. The LCAC is thus awarded six points for the MCO JOC and no points for the other JOCs. Overall, the LCAC has a composite Joint Utility score of six points.

The LCAC is a currently fielded platform and is thus awarded fifty points for Development Status.

The unit cost of the LCAC is about \$37 million each.<sup>109</sup> The 2015 MEB requirement is for thirty-one LCACs, so the total cost to field is about \$1,147 million. This results in a Cost to Field score of thirty points.

<sup>108</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 85.

<sup>109</sup> FY07 dollars. The FY90 proposed budget allocation for 9 LCACs was \$219.3 million. U.S. Congress, House, Committee on Appropriations, Subcommittee on the Department of Defense, *Department of*

### LCU-1600

The LCU-1600 is the current low-speed, heavy-lift, Seabase-to-objective surface connector. The LCU is a full-displacement landing craft that is capable of offloading onto a suitable beach and is compatible with the well decks of all current and planned amphibious ships. The LCU is about fifty percent longer and slightly narrower than an LCAC. Most amphibious ships can carry about the same numbers of LCUs as LCACs, although this varies somewhat from ship to ship based on the specific well deck configuration. Like the LCAC, the LCU is not self-deployable. An evolution of a design that dates back to World War II, the current generation of LCUs was built in the 1970s and is nearing the end of its useful life.

The Seabasing capabilities of the LCU are summarized in Table 23. The LCU is awarded five points for its ability to offload at a beach. The LCU therefore has a total Seabasing Utility score of twenty-seven points.

Metric	LCU Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	146	140	Tons	10
Speed	10	50	knots	2
Range	600	150	nm	10

**Table 23 – LCU Seabasing Utility<sup>110</sup>**

---

*Defense Appropriations for 1990: Hearing before a Subcommittee of the Committee on Appropriations, 101<sup>st</sup> Cong., 1<sup>st</sup> sess., 2 May 1989, part 6, 618.*

<sup>110</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 85.

Like the LCAC, the LCU is essentially a single-purpose platform, and provides only very limited capabilities to areas outside of Seabasing. However, with its shallow draft and large cargo capacity, the LCU can be used for riverine transport or as a staging platform/mother ship for small boats. In this role, the LCU can contribute to the HD/CS, MCO, Stability, and IW JOCs. As this type of capability is also provided by other small utility craft, the LCU is awarded three points for each of these JOCs. The LCU does not provide any significant utility to Deterrence or Shaping Operations. Overall, the LCU has a composite Joint Utility score of twelve points.

The LCU is a currently fielded platform and is therefore awarded fifty points for Development Status.

The unit cost of the LCU is about \$7.3 million each.<sup>111</sup> In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of sixteen LCUs would be required. This gives a total cost to field of about \$116.8 million. This results in a Cost to Field score of fifty points.

### *Joint Maritime Assault Connector*

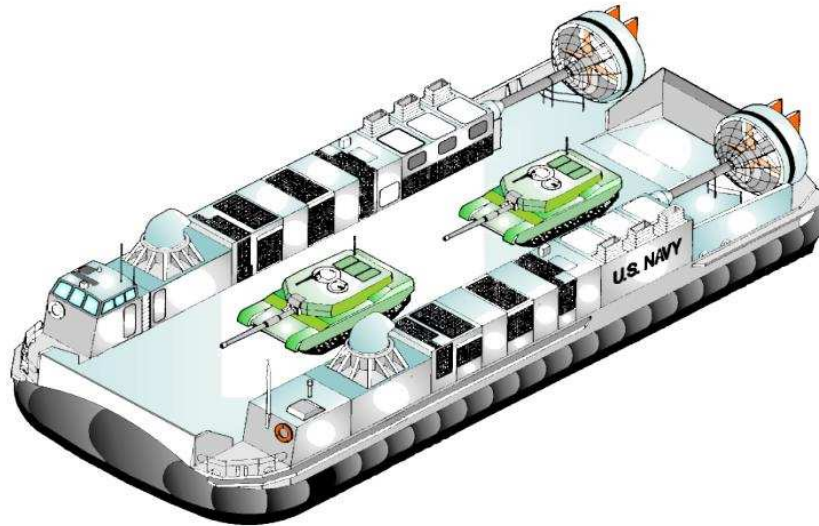
The Joint Maritime Assault Connector (JMAC) is the intended replacement for the LCAC. Although the program has undergone a number of name changes in recent years, the design requirements remain essentially unchanged.<sup>112</sup> It is intended to have an increase in payload capacity over the current LCAC, while retaining the LCAC's speed

---

<sup>111</sup> FY07 dollars. The FY85 proposed budget allocation for 2 LCUs was \$8.7 million. U.S. Congress, House, Committee on Appropriations, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1985: Hearing before a Subcommittee of the Committee on Appropriations*, 98th Cong., 2<sup>nd</sup> sess., 8 May 1984, part 6, 419.

<sup>112</sup> The LCAC replacement program has had various incarnations, being known as the Heavy Lift LCAC (HLCAC), LCAC(X), Ship-to-Shore Connector, and Seabase-to-Shore Connector (SSC).

and amphibious advantages. The most likely design is essentially a “stretched” LCAC, about fifty percent longer than the current version. The JMAC is in the development phase, and is planned to be delivered around 2015, as the SLEP LCACs reach their end-of-life.



**Figure 10 – JMAC Concept Design**

The Seabasing capabilities of the JMAC are summarized in Table 24. As it is a hovercraft, the JMAC is fully amphibious, earning ten additional points for this capability. The JMAC therefore has a total Seabasing Utility score of thirty-four points.

In terms of non-Seabasing applications, the JMAC holds the same value as the LCAC and thus has a composite Joint Utility score of six points.

The JMAC is relatively early in the design spiral, and is still working its way through the JCIDS process. The JMAC is therefore awarded twenty points for Development Status.

Metric	JMAC Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	144	140	Tons	10
Speed	35	50	knots	7
Range	100	150	nm	7

**Table 24 – JMAC Seabasing Utility<sup>113</sup>**

The expected unit cost of the JMAC is about \$83.2 million each.<sup>114</sup> In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of sixteen JMACs would be required. This gives a total cost to field of about \$1,331.2 million. This results in a Cost to Field score of thirty points.

#### *LCU-X*

Just as the JMAC is planned to replace the LCAC, the LCU-X program, previously known as LCU(R), is intended to replace aging LCUs with a similar design. The LCU-X is planned to have a slightly increased top speed, and fifty percent larger payload.

The Seabasing capabilities of the LCU-X are summarized in Table 25. The LCU-X is awarded five points for its ability to offload at a beach. The LCU-X therefore has a Seabasing Utility score of twenty-eight points.

<sup>113</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 85.

<sup>114</sup> FY07 dollars. Based on an estimated unit cost of \$89.1 million FY10 dollars. U.S. Department of Defense, Office of the Chief of Naval Operations, N85, Force Application FCB Working Group, *Ship-to-Shore Connector (SSC) Initial Capabilities Document* [Microsoft PowerPoint presentation] (Washington D.C., 2006), slide 12, accessed at <http://www.mfp.usmc.mil/TeamApp/G4Surface/Topics/20040923150704/FA%20FCB%20WG%20brief%206%20Jul%2006.ppt> on 9 February 2007.

Metric	LCU-X Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	212	140	Tons	10
Speed	13	50	knots	3
Range	600	150	nm	10

**Table 25 – LCU-X Seabasing Utility<sup>115</sup>**

In terms of non-Seabasing applications, the LCU-X holds the same value as the LCU and thus has a composite Joint Utility score of twelve points.

The LCU-X is still in the concept development phase, and is essentially only a set of requirements at this point. The LCU-X is therefore awarded ten points for Development Status.

The expected unit cost of the LCU-X is about \$26.8 million each, although this is a very rough estimate at this point in the program life.<sup>116</sup> In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of eleven LCU-Xs would be required. This gives a total cost to field of about \$294.8 million, resulting in a Cost to Field score of fifty points.

### *LCTAC*

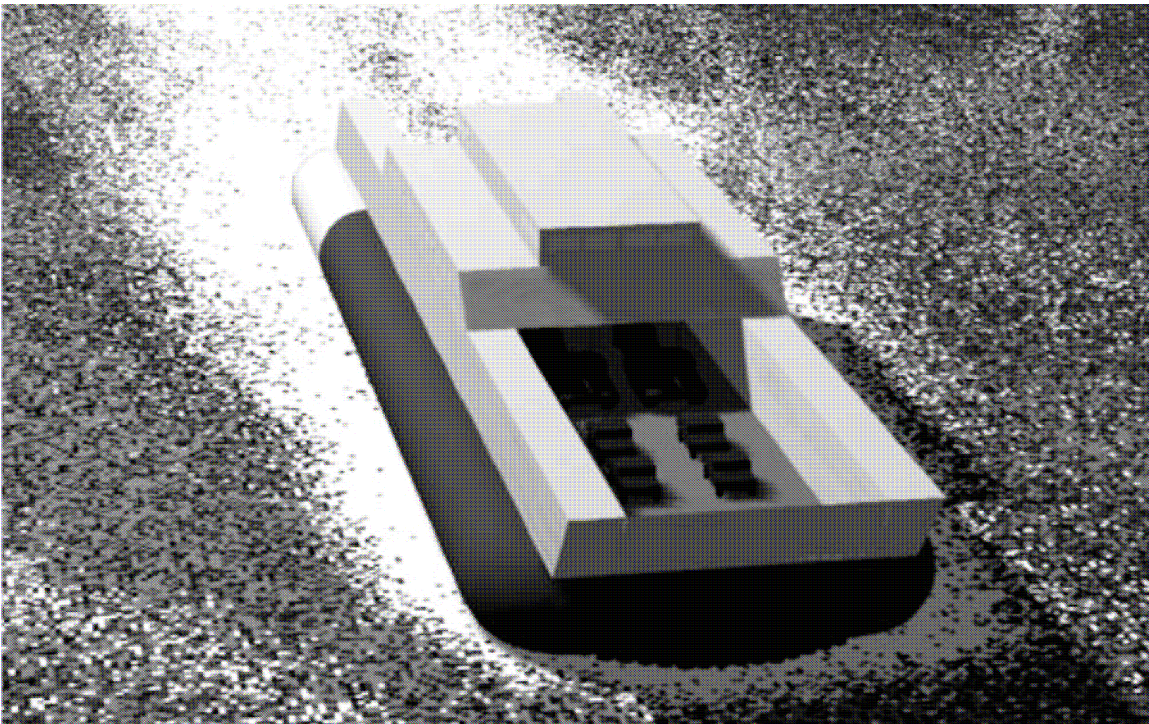
The Landing Craft, Tank, Air Cushion (LCTAC) is a Naval Sea Systems Command (NAVSEA) concept design for an air cushion vehicle with significantly more cargo capacity than an LCAC. It is envisioned to be large enough to be able to self-deploy to some extent. With an anticipated unloaded range of up to four thousand

<sup>115</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 85.

<sup>116</sup> FY07 dollars. Based on an estimated unit cost of \$24.9 million FY05 dollars. U.S. Department of Defense, Department of the Navy, *Fiscal Year (FY) 2006/FY 2007 Budget Estimates, Justification of Estimates: Shipbuilding and Conversion, Navy* (Washington, D.C., 2005), p. 20-1.



nautical miles, the LCTAC would be capable of self-deployment from the US to a Seabase at any location in the world, assuming appropriately located intermediate bases along the way.



**Figure 11 – LCTAC Concept Design**

The Seabasing capabilities of the LCTAC are summarized in Table 26. Unlike the LCAC, the LCTAC concept is a surface effect ship, rather than a true hovercraft, with rigid sidewalls for the air cushion. It would, therefore, be required to offload over the beach rather than being fully amphibious like the LCAC, and is awarded five points for this capability. The LCTAC therefore has a Seabasing Utility score of thirty-one points.

Metric	LCTAC Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	350	140	Tons	10
Speed	30	50	knots	6
Range	1000	150	nm	10

**Table 26 – LCTAC Seabasing Utility<sup>117</sup>**

In terms of non-Seabasing applications, the LCTAC holds the same value as the LCAC and thus has a composite Joint Utility score of six points.

The LCTAC is only a concept design at this point, with no programmatic funding attached. The LCTAC is therefore awarded ten points for Development Status.

Given the conceptual nature of the LCTAC, no cost estimates available. In comparison with the JMAC, it has a larger cargo capacity and range, which would tend to increase construction cost. The surface-effect design allows for significantly lower power requirements to maintain the air cushion, which would tend to reduce the construction cost somewhat due to the smaller power plant required. On the whole, the expected unit cost of the LCTAC should be a bit higher than for the JMAC, or about \$100 million each. In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of seven LCTACs would be required. This gives a total cost to field of about \$700 million and results in a Cost to Field score of forty points.

---

<sup>117</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 85-86.

## *Zubr*

The *Zubr* (Project 1232.2, NATO reporting name Pomornik) is an example of the high-end of military hovercraft design. A Soviet design constructed between 1986 and 2005, the *Zubr* is in service with the Russian, Ukrainian, and Greek navies. Russia recently signed a contract to sell six of the vessels to China.<sup>118</sup> It was designed to carry up to three T-80 tanks or a combination of lighter armored vehicles and troops up to three hundred miles at high speeds. The *Zubr* is armored and carries air defense weapons as well as unguided rockets to provide fire support for the landing forces.<sup>119</sup>



**Figure 12 – *Zubr***

<sup>118</sup> “Russian Shipbuilder to Sign Landing Craft Contract with China,” *News from Russia: Weekly News Bulletin Edited and Published by the Information Department of the Russian Embassy in India*, 8 September 2006, accessed at <http://www.india.mid.ru/nfr2006/nf31.html> on 7 March 2007, 13.

<sup>119</sup> “Project 1232.2 Zubr Pomornik Class Amphibious Landing Craft Specifications” in *Globalsecurity.org* (Globalsecurity.org, updated 22 April 2006, 22:17 UTC) [database on-line], accessed at [http://www.globalsecurity.org/military/world/russia/1232\\_2-specs.htm](http://www.globalsecurity.org/military/world/russia/1232_2-specs.htm) on 4 March 2007.

The Seabasing capabilities of the *Zubr* are summarized in Table 27. Like the LCAC, the *Zubr* is a true hovercraft, and is fully amphibious. It is therefore awarded ten points for this capability. The *Zubr* therefore has a Seabasing Utility score of forty points.

Metric	<i>Zubr</i> Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	140	140	Tons	10
Speed	60	50	knots	10
Range	300	150	nm	10

**Table 27 – *Zubr* Seabasing Utility<sup>120</sup>**

In terms of non-Seabasing applications, the *Zubr* is similar to the LCAC in its capabilities. Unlike the LCAC, it does not have the capability of being fitted with a minesweeping package. On the other hand, the *Zubr* is capable of being fitted with a mine-laying package, which would contribute to the MCO JOC. This role is currently filled in the US military by aircraft and submarines, and the *Zubr* would not provide an significant improvement over current platforms. Therefore, the *Zubr* is only awarded three points for contributing to the MCO JOC. Overall the *Zubr* has a composite Joint Utility score of three points.

The *Zubr* is fully-realized design, in service with several navies. The *Zubr* is therefore awarded forty points for Development Status.

The estimated unit cost of the *Zubr* of about \$69.5 million each.<sup>121</sup> Since Russia has sold several of these craft to Greece, a NATO country, it is possible that the US could

<sup>120</sup> Robert Button et al., *Ship Acquisition Options for Joint Forcible Entry Operations*, 86-88.

purchase some *Zubrs* directly or acquire the design and construction rights for indigenous production. In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of sixteen *Zubrs* would be required. This gives a total cost to field of about \$1,112 million and results in a Cost to Field score of thirty points.

### *Joint High Speed Vessel*

The Joint High Speed Vessel (JHSV) is a combined Army-Navy project to develop an intra-theater connector, primarily to fill an ALSS-to-Seabase role but also capable of offloading over the beach (with some assistance) or at an austere port facility. The key design features of the JHSV are shallow draft, long range, relatively high speed, roll-on/roll-off capability for vehicles, and the ability to land light and medium helicopters. The JHSV concept has been prototyped in the past few years through the lease of several different commercial high-speed ferries by the Army and Navy, including the *WestPac Express* (HSV 4676), *Joint Venture* (HSV-X1), *Spearhead* (TSV-1X) and *Swift* (HSV-2). All of these vessels are aluminum catamarans, directly adapted from commercial high-speed ferries. The ships have served in intra-theater lift roles worldwide, as a staging platform for SOF during OIF, and as a helicopter platform during

---

<sup>121</sup> FY07 dollars. Export cost of one unit sold to Greece in 2004 was \$62 million. "Largest Identified Transfers of Russian Arms in 2004," *Moscow Defense Brief* 1 (2005): 36.



tsunami relief efforts in Indonesia.<sup>122</sup> Procurement of the JHSV is expected to begin in FY09, with a total of three ships being procured by FY11.<sup>123</sup>



**Figure 13 – *Joint Venture* (HSV-X1) conducting flight operations**

The Seabasing capabilities of the JHSV are summarized in Table 28. Unlike the most of the other surface connectors, the JHSV is clearly capable of worldwide self-deployment, even with a full combat load. In addition, the ability to operate medium-lift helicopters increases the flexibility of the JHSV considerably. In fact, the JHSV straddles the line between staging platform and surface connector, and could be used a staging platform in a low-intensity scenario. In the staging platform role, the JHSV would provide about 28,000 square feet of vehicle space, carry as many as 1,000 troops,

<sup>122</sup> “HSV 4676 WestPac Express” in *Globalsecurity.org* (Globalsecurity.org, updated 21 August 2005, 19:07 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/agency/navy/hsv-4676.htm> on 26 March 2007;

“Joint High Speed Vessel [JHSV]” in *Globalsecurity.org* (Globalsecurity.org, updated 7 July 2006, 22:24 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/jhsv.htm> on 26 March 2007.

<sup>123</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion, Navy*, p. 20A-1.

or provide about 220,000 cubic feet of cargo space (or some combination of the three).

The JHSV is a displacement vessel and must offload at the shoreline. Even then, it will require some sort of causeway, barge or lighter system to offload onto an unimproved beach. It is therefore awarded no points for amphibious capability. The JHSV therefore has a Seabasing Utility score of twenty-eight points.<sup>124</sup>

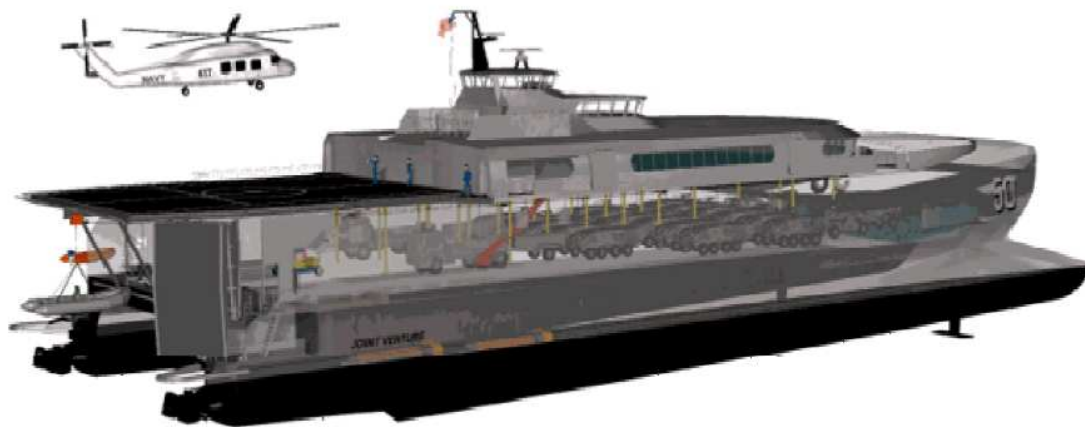
Metric	JHSV Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	600	140	Tons	10
Speed	40	50	knots	8
Range	1200	150	nm	10

**Table 28 – JHSV Seabasing Utility<sup>125</sup>**

In terms of non-Seabasing applications, the JHSV provides capabilities that are similar to those provided by the larger amphibious ships. It could serve as a base of operations for HD/CS missions, as a platform for maritime interdiction operations or mine hunting for MCO, as a sealift asset and/or aircraft operation platform for SSTR, or as an AFSB for IW. In all these cases, the JHSV provides an improvement in capability due to its high speed relative to other ships capable of conducting those missions. Therefore, the JHSV earns six points for each of the HD/CS, MCO, SSTR, and IW JOCs; it does not provide a significant contribution to the Shaping or Deterrence JOCs. Overall the JHSV has a composite Joint Utility score of twenty-four points.

<sup>124</sup> Measured as a staging platform, the JHSV would have a Seabasing Utility score of eight points.

<sup>125</sup> U.S. Department of Defense, Marine Forces Pacific, *Marine Air-Ground Task Force Composition and Utilization* [Microsoft PowerPoint presentation] (Washington D.C., 2006), slide 19.



**Figure 14 – JHSV Concept Design**

The JHSV is fully-realized design, based on off-the-shelf commercial technology. Its prototypes have proven themselves in active service. The JHSV is therefore awarded fifty points for Development Status.

The estimated unit cost of the JHSV of about \$177 million each.<sup>126</sup> In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of four JHSVs would be required. This gives a total cost to field of about \$708 million. This results in a Cost to Field score of forty points.

#### *Pelican WiG*

The Wing-in-Ground Effect (WiG) concept is a type of seaplane that achieves significantly improved fuel efficiency by operating very close to a relatively flat surface (such as the ocean). Many small prototype craft using this technology have been flown since the 1960s. The USSR developed several production models, including one

---

<sup>126</sup> *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion, Navy*, p. 20A-1.



intended as an amphibious landing craft. The *Orlan* (Project 904) class was capable of carrying 200 troops and 20 tons of cargo at 200 knots, flying about ten feet off the water. A larger prototype, nicknamed the “Caspian Sea Monster” by western intelligence services, could lift up to 540 tons at a speed of 300 knots.<sup>127</sup> A concept design being studied by Boeing, the *Pelican* could conceivably carry 1,400 tons of cargo up to 10,000 nm.<sup>128</sup> The disadvantages to WiG craft are that they are generally too large to load aboard a ship and would therefore present some challenges in cargo transfer. Depending on the design, a WiG craft may or may not be capable of landing on a traditional runway or beaching itself for offloading cargo. For the purposes of this study, the *Pelican* design characteristics will be considered.

The Seabasing capabilities of the *Pelican* are summarized in Table 29. The *Pelican* is capable of worldwide self-deployment, even with a full combat load. The *Pelican* would have to land at either a large, conventional runway or on the surface of a suitably large body of water. If water landing was used, it would then be required to beach and offload at the shoreline. It is therefore awarded five points for amphibious capability. In total, the *Pelican* has a Seabasing Utility score of thirty-five points.

---

<sup>127</sup> “Project 904/902R Orlan Class Amphibious Landing Craft” in *Globalsecurity.org* (Globalsecurity.org, updated 22 April 2006, 22:16 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/world/russia/904.htm> on 4 March 2007.

<sup>128</sup> William Cole, “The Pelican: A Big Bird for the Long Haul,” *Boeing Frontiers Online* 1, no. 5 (September 2002) accessed at [http://www.boeing.com/news/frontiers/archive/2002/september/i\\_pw.html](http://www.boeing.com/news/frontiers/archive/2002/september/i_pw.html) on 4 March 2007.

Metric	<i>Pelican</i> Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	1,400	140	Tons	10
Speed	~250	50	knots	10
Range	10,000	150	nm	10

**Table 29 – *Pelican* Seabasing Utility<sup>129</sup>**



**Figure 15 – *Orlan* in flight**

In terms of non-Seabasing applications, the *Pelican* fills a role similar to that of a large cargo aircraft such as the C-5, with substantial improvement in payload capacity and the ability to conduct water landings. This sort of airlift capability is an enabler for

---

<sup>129</sup> Ibid.

all JOCs. Therefore, the *Pelican* earns six points for each JOC, with a composite Joint Utility score of thirty-six points.

The *Pelican* is still very much a concept design. Although several technology demonstrators have been built and operated, there are still many challenges and unknowns in WiG technology. The *Pelican* is therefore awarded ten points for Development Status.



**Figure 16 – Pelican Concept Design**

A rough estimate of the unit production cost of the *Pelican* can be made by comparing it with a large transport aircraft such as the C-5 *Galaxy*. The C-5 has a unit cost \$226.3 million each.<sup>130</sup> Since the *Pelican* would have a cargo capacity about ten times that of the C-5, the estimated cost of the *Pelican* is about \$2,263 million each. In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, two

<sup>130</sup> Based on \$179 million FY98 dollars, U.S. Department of Defense, Department of the Air Force, *Factsheets: C-5 Galaxy* (Washington, D.C., 2006) accessed at <http://www.af.mil/factsheets/factsheet.asp?id=84> on 4 March 2007.

*Pelicans* would be required. This gives a total cost to field of about \$4,526 million, resulting in a Cost to Field score of ten points.

### *Walrus*

The *Walrus* is a lighter-than-air vehicle concept design that was pursued by the Defense Advanced Research Projects Agency in 2005; the program was cancelled in 2006. The goal of the *Walrus* design was to be able to deploy a “Unit of Action” in a combat-loaded configuration directly from “Fort to Fight,” at transcontinental distances into unimproved landing zones.

The Seabasing capabilities of the *Walrus* are summarized in Table 30. The *Walrus* would be capable of worldwide self-deployment with a full combat load. It would also be capable of conducting cargo transfer operations with any ship that has a suitably large flight deck and offload at any reasonably clear landing area. It is therefore awarded ten points for amphibious capability. The *Walrus* has a total Seabasing Utility score of forty points.

Metric	<i>Walrus</i> Capability	Seabasing Requirement	Units	Seabasing Utility Score
Cargo Capacity	500	140	Tons	10
Speed	~75	50	knots	10
Range	12,000	150	nm	10

**Table 30 – *Walrus* Seabasing Utility<sup>131</sup>**

<sup>131</sup> U.S. Department of Defense, Defense Advanced Research Projects Agency, *Walrus Global Reach Air Vehicle Design Program: Phase I Program Solicitation PS05-01* (Washington, D.C., 2005), 2.

In terms of non-Seabasing applications, the *Walrus* fills a role similar to that of a large cargo aircraft such as the C-5, with substantial improvement in payload capacity, but at the cost of much lower speed and more combat vulnerability. This sort of airlift capability is an enabler for all JOCs. Therefore, the *Walrus* earns six points for each JOC, with a composite Joint Utility score of thirty-six points.

The *Walrus* is only a concept design, with no significant progress made towards developing an operational demonstrator. The *Walrus* is therefore awarded ten points for Development Status.



**Figure 17 – *Walrus* Concept Design**

Similar to the *Pelican*, a rough estimate of the unit production cost of the *Walrus* can be made by comparing it with the C-5. Since the *Walrus* would have a cargo capacity about four times that of the C-5, an estimated cost of the *Walrus* is about \$905.2 million each. In order to provide the same tonnage capability to the 2015 MEB as thirty-one LCACs, a total of five *Walrus* craft would be required. This gives a total cost to field of about \$4,526 million, resulting in a Cost to Field score of ten points.

#### Key Capability Area #4 – At-Sea Bulk Cargo Transfer

One of the most crucial enabling capabilities in Seabasing is the ability to safely transfer items from one platform to another. Although this basic capability has existed for a long time, the Seabasing model adds requirements in terms of operable sea states, size/weight of individual items transferred, and overall volume of material required that exceed the bounds of current technology and require further development to achieve. This section will examine three basic ways to conduct at-sea bulk cargo transfer. Bulk liquid transfer is not addressed because the technologies required for this, in the sea conditions and amounts required by Seabasing, are well-developed and in service throughout the military and civilian sectors.

##### *Transfer to Internal Lighters*

The first fundamental method for platform-to-platform cargo transfer is to move the payload from the sending platform to a shuttle vessel, or lighter, that is carried aboard the sending platform. The loaded lighter then debarks from the sending platform, moves to the destination platform, and is embarked aboard the destination platform. The payload is then moved from the lighter to the destination platform. A real-world example of this would be using an LCAC to transfer an armored vehicle from one amphibious ship to another.

With respect to meeting the requirements of Seabasing, the current existing capabilities in the area of transfer to internal lighters are shown in Table 31. One limiting factor in currently-fielded systems is the sloshing of water in enclosed wet well decks. This makes transfers unfeasible in sea states above three. Well decks can be pumped dry

to avoid this pitfall, but this increases the time required to complete the transfer operation for displacement lighters like the LCU. Another limitation is the pendulum-like motions of a suspended load during transfer, although this does not inhibit the ramp-loading of vehicles to an embarked lighter. Current crane systems also reach their practical limits around sea state three. These ship-motion induced limitations can be mitigated by providing active and/or passive ship stabilization systems (common in commercial cruise liners), increasing ship size, or providing a motion-compensation system for internal cranes.<sup>132</sup>

The largest capacity well deck crane on a current ship is fifteen tons (on the LSD 41 class).<sup>133</sup> A nominal forty-foot container would be too heavy for this internal crane to carry, so this transfer method is limited to twenty-foot containers, giving an ISO compatibility score of five points. An LCAC is capable of carrying seventy tons of cargo (or two nominal forty-foot ISO containers), with an arrival-to-departure load time of about forty minutes.<sup>134</sup> This gives a throughput rate of three nominal containers per hour. An LCU would be able to carry about twice as much cargo per load, but with correspondingly longer loading times, essentially achieving nearly the same throughput. Technology for transfer to internal lighters has an overall Seabasing Utility score of twenty-three points.

---

<sup>132</sup> *Defense Science Board*, 60.

<sup>133</sup> *Amphibious Ships and Landing Craft Data Book*, 19.

<sup>134</sup> Peter J. Thede, Richard C. Staats, and William S. Crowder, *Assessment of the Heavy Lift Landing Craft, Air Cushioned* (McLean, VA: Logistics Management Institute, 1995), pp. B-1 to B-2.

Metric	Transfer to Internal Lighters Capability	Seabasing Requirement	Units	Seabasing Utility Score
Max Load	15	35	Tons	4
Throughput	3	5	Containers/ hour	6
Max Sea State	3	4	–	8

**Table 31 – Transfer to Internal Lighters Seabasing Utility**

The technologies required for improving the ability to conduct bulk cargo transfers to internal lighters are essentially Seabasing-only in application and have only minimal value for other JOCs. Therefore, this technology receives no points for composite Joint Utility.

Current systems used by the military to transfer cargo via internal lighters do not meet the Seabasing metrics. Technological advances in ship stabilization, larger capability cranes, and crane motion stabilization are available in the commercial sector and could be applied with relatively little impact to new Seabasing staging platform designs. Research and development efforts towards this end are in progress as part of the MPF(F) design project. Transfer to internal lighters is therefore awarded a Developmental Status score of forty points.

Estimating the cost to fit Seabasing ships with improved internal lighter transfer capability is problematic. A rough guess may be performed by comparing the cost of a typical port container crane. Given that a typical container crane costs about \$6 million, and assuming that a motion-stabilized crane would be about twice as expensive, that



would give a cost of about \$12 million per ship (one crane/ship).<sup>135</sup> For a Seabasing force that contained four well deck ships (two LHD, one LSD, one LPD), that would give a cost to field of \$48 million, and a Cost to Field score of fifty points.

### *Transfer to External Lighters*

The second fundamental method for platform-to-platform cargo transfer is to move the payload from the sending platform to a shuttle vessel, or lighter, that is brought adjacent to the sending platform. The loaded lighter then moves from the sending platform to a spot adjacent to the destination platform. The payload is then moved from the lighter to the destination platform. A real-world example of this would be using an LCU or barge to transfer cargo containers from one lift-on/lift-off (LO/LO) container ship to another. Another example would be the transfer of vehicles from an LMSR to an MLP via the LMSR's ramp. The significant differences here are the lighter remains outside of the staging platform, connected in some way, and that there is no requirement for a well deck in the staging platform.

Transfer to external lighters suffers from some of the same problems as transfer to internal lighters, particularly with respect to pendulum-like motions of suspended cargo. Additionally, external lighters suffer from the problem of maintaining position relative to, and perhaps connection with, the staging vessel in high seas, when the two vessels are both moving due to wave action. Solutions to these problems are more challenging than for internal lighters, as the large difference in size between the lighter and the staging platform exaggerates the differences in response to waves, and hence the relative motion

---

<sup>135</sup> NZ\$9 million converts to about US\$6 million. "New Cranes a Christmas Present for Auckland," *Ports of Auckland Newsroom*, 13 December 2006, accessed at <http://www.poal.co.nz/newsroom/New%20Cranes%20061213.htm> on 6 March 2007.

between the two. Some ways to mitigate this problem include dynamic motion prediction and control (most effective on the lighter), some sort of deployable sheltering/breakwater system to protect the lighter from waves, and motion-compensated crane and ramp control systems. Crane and ramp control is significantly more difficult for this case, as the ship-to-cargo-to-lighter relative motions are greater than experienced in an internal loading scenario. Current technologies are not capable of providing dynamic motion control or crane/ramp control in sea state three conditions. A deployable breakwater of some sort is a promising concept, but has yet to be demonstrated on a practical scale.

Characteristics of currently deployed systems for transfers to external lighters are shown in Table 32. Large cranes capable of easily handling the nominal forty-foot ISO container are common on Seabasing ship designs, and ten points are awarded for this capability. Exercises have shown that single-crane LO/LO systems are capable of discharging up to 150 containers/day (or 6 containers/hour).<sup>136</sup> The most significant obstacle in this concept is sea state. With current technology and equipment, this capability requires calm seas, and in no case greater than sea state two.<sup>137</sup> Technology for transfer to external lighters has an overall Seabasing Utility score of thirty-five points.

The technologies required for improving the ability to conduct vehicle and cargo transfers to external lighters are essentially Seabasing-only in application and have only minimal value for other JOCs. Therefore, this technology receives no points for composite Joint Utility.

---

<sup>136</sup> “Logistics Over-the-Shore [LOTS]” in *Globalsecurity.org* (Globalsecurity.org, updated 17 July 2006, 21:57 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/lots.htm> on 6 March 2007.

<sup>137</sup> *Defense Science Board*, 61.

Metric	Transfer to Internal Lighters Capability	Seabasing Requirement	Units	Seabasing Utility Score
Max Load	60	35	Tons	10
Throughput	6	5	Containers/ hour	10
Max Sea State	2	4	–	5

**Table 32 – Transfer to Internal Lighters Seabasing Utility**

Currently fielded systems for transfer to external lighters do not meet the Seabasing metrics. Technological advances required to meet these metrics do not currently exist beyond research and development initiatives. Transfer to external lighters is therefore awarded a Developmental Status score of twenty points.

Estimating the cost to fit Seabasing ships with improved external lighter transfer capability is even more problematic than determining the cost of improving internal lighter transfers. Again, the basis for a rough guess may be the cost of a typical port container crane. Assume, as above, that a motion-stabilized crane or ramp system would be about \$12 million per copy. Each T-AKR, LMSR or JHSV would require a ramp system and each Legacy T-AK would require a crane system. Assume that a mobile breakwater system would be about \$10 million per copy, and that one mobile breakwater system would be required for each MLP. For a Seabasing force that contained three T-AKR LMSRs, three MLPs, two Legacy T-AKs, and four JHSVs, that would give a cost to field of \$138 million, and a Cost to Field score of fifty points.

### *Direct Ship-to-Ship Transfer*

Direct ship-to-ship transfer involves bringing two staging platforms close together and transferring cargo directly from the sending platform to the destination platform. For bulk cargo, this type of transfer is typically conducted using a rig that connects the platforms with a tensioned steel cable and moving the cargo along that cable from one platform to the other. This is a very mature technology, used daily worldwide by US Navy vessels ever since World War II for underway replenishment (UNREP). The process is routinely conducted in conditions up to sea state four, and is possible up to sea state five. The major drawback to the direct ship-to-ship transfer technique is its limited weight—current systems are limited to 5,700 lbs, which is not enough to support even a nominal twenty-foot ISO container.<sup>138</sup> Throughput for the current system is about 37.5 tons/hour per transfer rig, and most ships have at least two rigs.<sup>139</sup> This results in a throughput of about 75 tons/hour, or about 2.1 nominal forty-foot ISO containers per hour. Characteristics of systems currently deployed for transfers to external lighters are shown in Table 33. Technology for direct ship-to-ship transfer has an overall Seabasing Utility score of fifteen points.

---

<sup>138</sup> “CONREP Standard Tensioned Replenishment Alongside Method (STREAM)” in *Globalsecurity.org* (Globalsecurity.org, updated 19 July 2006, 17:21 UTC) [database on-line], accessed at <http://www.globalsecurity.org/military/systems/ship/systems/unrep-stream.htm> on 6 March 2007.

<sup>139</sup> Mark E. Johnson, “The Joint Modular Intermodal Container, is this the Future of Naval Logistics?” (Master’s thesis, Cambridge, MA: Massachusetts Institute of Technology, 2005), 22.

Metric	Direct Ship-to-Ship Transfer Capability	Seabasing Requirement	Units	Seabasing Utility Score
Max Load	2.9	35	Tons	1
Throughput	2.1	5	Containers/hour	4
Max Sea State	5	4	–	10

**Table 33 – Direct Ship-to-Ship Transfer Seabasing Utility**

The technologies required for improving the ability to conduct direct ship-to-ship transfers are mostly Seabasing-only in application and have only minimal value for other JOCs. One exception to this is in the support of MCO. Higher capacity ship-to-ship transfer systems are also being researched for inclusion in the next generation aircraft carrier design in order to enable more rapid rearming to allow increased ordinance delivery rates for carrier-based strike aircraft. This would provide an improvement above current capability for UNREP. Therefore, this technology is given six points because of its applicability to the MCO JOC. Thus, ship-to-ship transfer technology receives a total of six points for composite Joint Utility.

Although currently fielded systems for ship-to-ship transfer do not meet the Seabasing metrics, several parallel efforts are underway to improve the current process. The Heavy UNREP system, in the research and development phase, expands the upper weight limit to 12,000 pounds. A more distant research program, High Capacity At-Sea Sustainment (HiCASS), has the goal of further expanding this limit up to 53,000 lbs.<sup>140</sup>

Approaching the problem from a different angle, research is also underway towards

---

<sup>140</sup> U.S. Department of Defense, Naval Surface Warfare Center, Littoral Warfare Systems Product Area Directorate, *Seabasing S&T And R&D: Roadmap for a Joint Capability* [Microsoft PowerPoint presentation] (Washington, D.C., 2006), slides 26 & 27.

direct skin-to-skin mooring technologies which would allow the use of large cargo cranes to transfer loads directly between staging platforms. Again, this works well now in calm water, but significant developmental challenges are faced in extending this capability to high sea state operations. Ship-to-Ship transfer is therefore awarded a Developmental Status score of twenty points.

Like other transfer technologies, estimating the cost to fit Seabasing ships with improved ship-to-ship cargo transfer capabilities requires making some assumptions. Assuming that improved transfer rigs may cost up to \$10 million per ship, the cost to fit all seventeen Seabasing ships in the ESG and MPF(F) squadron would be about \$170 million, giving a Cost to Field score of fifty points.

#### Key Capability Area #5 – Logistics Support Technologies

Logistics support technologies is the final Seabasing key capability area to be examined. A significant portion of the transformational value of Seabasing is in its ability to eliminate the “iron mountain” of supplies stored ashore. It is not enough to have staging platforms and connectors that are capable of supporting the force ashore. It is just as important that the underpinning logistics systems are capable of the flexibility required to make sure that the right supplies get to the right people and at the right time. The two technologies reviewed in this section are critical enabling capabilities for accomplishing this task.

*Joint Modular Intermodal Distribution System*

Much of the discussion so far on cargo transfer capabilities has revolved around the ISO twenty-foot and forty-foot containers. These commercial-standard containers are the predominant method for the shipment of bulk cargo world-wide, both military and non-military. These containers are very efficient in moving large quantities of materials along established routes, but present challenges in delivering just the right amounts of just the right things to many locations near-simultaneously. An additional challenge is that airlift assets have traditionally used a different type of standard cargo pallet, the 463L, which is not directly compatible with ISO containers.

The Joint Modular Intermodal Distribution System (JMIDS) is an attempt to tackle these challenges by fundamentally overhauling the way that the military packages and ships cargo. The concept is a series of small containers that are linked together into a larger conglomeration that fits the form factor of a twenty-foot ISO container. This allows for use of established systems for rapidly handling large numbers of ISO containers, while allowing for rapid break-down of the larger container into smaller units for warehouse storage and further distribution without having to manually unload a container onto pallets, as is the current practice. The smaller containers, known as Joint Modular Intermodal Containers (JMICS), are capable of being directly loaded onto airlift platforms using the same handling systems as current 463L pallets. JMICS could come in various sizes that are multiples of the smallest unit container to allow for larger cargo items. To aid in retrograding empty containers, JMICS are designed to fold down into a flat form that can be easily stacked, minimizing the space taken up by empties.<sup>141</sup>

---

<sup>141</sup> Johnson, "The Joint Modular Intermodal Container", 29-34.

In terms of support for Seabasing, the JMIDS concept fully supports all of the major Seabasing requirements. The modularity allows for rapid breakdown from ISO-size containers into smaller units, giving it ten points. Standardized JMIC sizes support shipboard warehouse and cargo handling automation. The ISO-compatibility of the JMIC combinations allows them to be easily handled by legacy and commercial-grade container cargo handling systems, giving the concept another ten points. JMICS are intended to be fitted with radio frequency identification (RFID) tags to assist in automated asset tracking. This capability supports in-transit visibility and automated selective offload initiatives, giving the concept an additional twenty points. Overall, the JMIDS concept has a Seabasing Utility Score of forty points.



**Figure 18 – Several JMICS combined into a twenty-foot ISO equivalent**

In the Joint arena, outside of Seabasing, the JMIDS concept would be widely useful. It would be a notable upgrade to the current system of pallets and containers in



the military transportation system, particularly with respect to the land/air and sea/air transport interfaces. As such, JMIDS is awarded six points for each JOC for an overall Joint Utility score of thirty-six points.

The JMIDS program is in the prototyping and testing phases. Full-scale demonstration containers have been constructed and are undergoing utility and compatibility testing. JMIDS is therefore awarded a Development Status score of thirty points.

Estimating the cost of a MEB's worth of JMICS is very challenging. Assuming that all of the MEB's cargo in the MPF(F) squadron is containerized gives about 500 twenty-foot ISO containers' worth of cargo.<sup>142</sup> The MEB would require about 1.4 million cubic feet of cargo for thirty days of sustainment.<sup>143</sup> Based on having enough containers to fill the supply chain all the way back to CONUS, assume that three complete sets of thirty-days-sustainment containers are needed. This gives a total of 4.2 million cubic feet, or about 3,300 twenty-foot ISO containers.<sup>144</sup> Rounding this to about 4,000 containers total, and assuming that there are an average of eight JMICS of various sizes in each twenty-foot container equivalent (this number could vary from only one to a maximum of sixteen), gives a total of 32,000 JMICS required in all. A generic twenty-foot ISO container costs about \$2,500 dollars.<sup>145</sup> Assuming that each JMIC would cost twice that, it would require about \$160 million to procure the containers

---

<sup>142</sup> A twenty-foot ISO container can hold about  $8' \times 8' \times 20' = 1280$  cubic feet. 560,000 cubic feet required for the MEB divided by 1280 cubic feet per container gives 473.5 containers.

<sup>143</sup> Calvano et al., *SEA FORCE*, 26.

<sup>144</sup> 4,200,000 cubic feet required divided by 1280 cubic feet per container gives 3281 containers.

<sup>145</sup> Alexander Jung, "The Box That Makes the World Go Around," *Spiegel Online International*, 25 November 2005, accessed at <http://www.spiegel.de/international/spiegel/0,1518,386799,00.html> on 26 February 2007.

required to support a MEB from the Seabase.<sup>146</sup> This gives a Cost to Field score of fifty points.

### *Shipboard Automated Warehousing*

The second critical enabling technology for Seabasing logistics support is automated shipboard warehousing. The basic concept is to have a computer database that has real-time knowledge of where each item stored in the warehouse is exactly located, coupled with robotics technologies to allow for the automatic selection, retrieval, and delivery of any item in the warehouse. Systems with this type of capability are available in the commercial sector, but the hardware is not easily adapted to the shipboard environment due to primarily to space and form factor constraints. A system with similar technology, but dealing exclusively with ordnance rather than with generally bulk cargo, is the NAVSTORS system that has been proposed for aircraft carrier magazine storage.<sup>147</sup>

The Office of Naval Research is conducting a research effort called Sea Base Transformational Package and Ordnance Rapid Transfer System (TransPORTS) Prototype Demonstrator, which is an automated warehouse concept built around various size JMICs, five-foot ISO containers (also known as QUADCONS), and legacy pallets. The system design specifications call for it to be capable of moving cargo between the main deck and storage holds on several decks, complete tracking of all items in the system, full random access to any item stored, and a system-wide inventory capability.<sup>148</sup>

---

<sup>146</sup> \$5,000 per container times 32,000 containers is \$160 million.

<sup>147</sup> NAVSTORS Automated Stowage and Retrieval System (Agile Systems Inc., 2005), accessed at <http://www.agilesystems.com/navstors%20system.htm> on 6 March 2007.

<sup>148</sup> U.S. Department of Defense, Office of Naval Research, *Sea Base Transformational Package and Ordnance Rapid Transfer System (TransPORTS) Prototype Demonstrator Broad Agency Announcement* (Washington, D.C., 2005), 2-3.

For Seabasing applications, the TransPORTS concept would fully support the Logistics Support objectives of selective offload, modularity, and in-transit visibility, resulting in thirty points. Since the system would support JMICs and QUADCONS, but not twenty-foot or forty-foot ISO containers, it only partially meets the objective of ISO compatibility and is therefore awarded an additional five points. Overall, a shipboard automated warehousing system such as TransPORTS would have a Seabasing Utility score of thirty-five points.

Outside of Seabasing, a shipboard automated warehousing system would provide some utility in supporting naval operations across the various JOCs. As this would provide an improvement on the current capability, this technology is awarded thirty-six points for Joint Utility.

Since both the TransPORTS and NAVSTORS systems are in the design and prototyping phase, twenty points are awarded for Developmental Status.

As with many developmental technologies, cost estimates for an automated warehousing system is difficult. A small commercial automated warehousing system, controlling about 27,000 cubic feet of warehouse space, is estimated to cost about \$350,000.<sup>149</sup> Extrapolating this to the total MEB cargo space requirement of 560,000 cubic feet and applying a two hundred percent mark-up premium for shipboard installation gives an estimated cost to field of about \$21.7 million. This gives a Cost to Field score of fifty points.

---

<sup>149</sup> *Hargrove Fires Up Gas Log Production with Automated Use-Point-Manager System* (Dallas, TX: Cisco-Eagle Inc., 2007), accessed at <http://www.cisco-eagle.com/CaseStudies/Printable/hargrove.pdf> on 6 March 2007.

### **Analysis, Conclusions, and Recommendations for Further Study**

The basic objectives, or desired effects, of Seabasing are three-fold. First, it will enable the Joint Force to reduce “flash-to-bang” time from decision to undertake a limited land operation until commencement of that operation by about two weeks from traditional amphibious operations by eliminating the need to build the “iron mountain” ashore before starting operations. Second, Seabasing enables the Joint Force to conduct operations that would not otherwise be possible due to political constraints by eliminating the need for friendly host nation access. Third, for large land campaigns, Seabasing defers the time until the Joint Force commander must have a large supply base ashore to continue operations. It is important to note that this is a postponement only, and not a complete elimination, as it is beyond the capability of Seabasing, even in the most optimistic case, to sustain more than a couple of brigades ashore. These are worthy objectives, but to be able to successfully achieve them, military decision makers need to efficiently allocate the scarce budgetary resources towards the various research, development, procurement, testing, and training components of Seabasing.

It is important to use a comprehensive, qualitative approach to prioritizing and selecting alternatives. Now that each of the potential solutions to each of the key capability areas has been evaluated and scored, the next step is to compare them and create a prioritized list of recommendations for further development. The individual metric and combined scores for each of the potential solutions, ranked from highest to lowest total score within each key capability area, are shown in Table 34. Reviewing these results, a number of conclusions and recommendations can be drawn regarding how to most efficiently proceed with the development and fielding of Seabasing.

	Seabasing Utility	Joint Utility	Developmental Status	Cost To Field	Total Score
<b>Staging Platforms</b>					
T-AKE	14	36	50	30	130
LHA	11	28	50	40	129
LSD 49	7	28	50	40	125
LSD 41	5	28	50	40	123
LPD 17	8	28	50	30	116
LPD 4	6	28	50	30	114
LHD	13	28	50	20	111
Legacy T-AK	18	3	50	40	111
Maersk S-Conversion	16	19	30	40	105
T-AKR (LMSR)	14	3	50	20	87
LHA(R)	9	28	30	10	77
MPF-2010	24	28	10	10	72
MLP	7	3	30	20	60
Sea Force	22	28	10	0	60
<b>Aircraft Connectors</b>					
CH-53E	38	36	50	50	174
MV-22	44	36	50	20	150
CH-53K	41	36	20	30	127
V-44 QTR	50	36	10	30	126
CH-46	20	18	50	30	118
Sikorsky X2HSL	40	36	10	30	116
<b>Surface Connectors</b>					
JHSV	28	24	50	40	142
LCU	27	12	50	50	139
Zubr	40	3	40	30	113
LCAC	25	6	50	30	111
LCU-X	28	12	10	50	100
Walrus	40	36	10	10	96
Pelican WiG	35	36	10	10	91
JMAC	34	6	20	30	90
LCTAC	31	6	10	40	87
<b>At-Sea Bulk Cargo Transfer</b>					
Internal	23	0	40	50	113
External	35	0	20	50	105
Direct	15	6	20	50	91
<b>Logistics Support</b>					
JMIDS	40	36	30	50	156
Automated At-Sea Warehousing	35	36	20	50	141

Table 34 – Summary of scores, sorted by total score in each Key Capability Area

With respect to staging platforms, current-generation ships provide much of the carrying capacity that Seabasing requires. New designs, especially the LHA(R) and some of the more fanciful concept designs, are very expensive and do not provide enough of an improvement over current ships to warrant their large price tags. Less expensive surrogates for future Seabasing platforms should be pursued in the short term. Some likely candidates are the Maersk S-class conversion and the use of existing heavy lift ships as stand-ins for MLPs. These surrogates and existing amphibious and MPF ships should be used to test emerging technologies, doctrine, and procedures prior to investing billions of dollars and many years in new ship construction. The designs that are already in production (LPD 17 and T-AKE) should continue to be acquired as needed for their non-Seabasing applications and integrated into Seabasing testing and development along with existing ships.

For aircraft connectors, the combination of the CH-53E and MV-22 are close to providing what is required for a true Seabasing air connector. These aircraft can and should be used for Seabasing testing. If Seabasing is to reach its full potential, a concerted effort needs to be made to develop a long-range, high-speed, heavy-lift cargo aircraft. Something that meets the Seabasing requirements would be universally valuable throughout the Joint Force and across the spectrum of conflict. What, precisely, this aircraft may end up looking like is still very much in doubt. Given the Army's requirement for landing in austere areas and that no Seabasing staging platform on the horizon could handle a more traditional C-130-like aircraft, it is fairly certain that the result will have to be some sort of V/STOL rotorcraft.

Surface connectors are probably the most mature area of Seabasing technology. The LCAC and leased catamarans like *Joint Venture* are able to meet most Seabasing requirements today. The JHSV is a very good investment. Its relatively cheap, technologically mature, and proven to be valuable in a wide variety of situations, both in and out of Seabasing. As an aside, a JHSV platform could probably fulfill most of the roles envisioned for the Littoral Combat Ship (LCS) as well. The *Zubr* is a surprisingly good fit for Seabasing. It indicates that the pursuit of a larger, self-deploying hovercraft is technologically feasible and may be worth exploring. One interesting note from the surface connector analysis is that if enough of a permissive environment can be created to get the staging platforms close to shore, the most efficient way to move large quantities of material from the ship to the beach is still the low-tech, dirt-cheap LCU.

The most critical area of development required to fully realize Seabasing is in the enabling technologies of at-sea cargo transfer and logistics support. At-sea transfer is nowhere near meeting the benchmarks to reliably support Seabasing in any but the most permissive environments, and the ability to do this routinely and safely in heavy seas is absolutely essential to the success of Seabasing. On the plus side, this is mostly an engineering problem that is solvable in the near- to medium-term given sufficient resources. The technologies for at-sea transfers are also the kinds of thing that, once successfully implemented, can be retrofitted onto existing platforms at relatively low cost. JMIDS is probably the biggest “bang-for-the-buck” program related to Seabasing at the moment. This system has the potential to truly revolutionize the way material is moved in the military, and is easily within current technologies to implement. The DoD-wide cost to implement JMIDS is substantially larger than is presented here due to the

limited scope of the cost analysis, but it is not insurmountable by any means and the system will most likely pay for itself in the near term. In fact, the biggest barrier to implementation of JMIDS is not technological or financial, but cultural. It requires a different way of thinking about how to order, package, store, and issue materials.

Automated warehousing technologies are well within the realm of the possible and are relatively inexpensive as well. Installing systems like this on current CLF, MPS and amphibious ships (where the configuration supports) and designing future ships of these types with this in mind from the beginning is essential.

In the course of this research, some limitations to the process outlined here became apparent. This analysis looks at the Seabasing concept from a component level to attempt to determine prioritization. One drawback to this is that, at its heart, the Seabasing concept is a *system of systems* and each piece cannot truly be looked at in isolation. In other words, a fully-formed Seabasing solution needs to include all of the pieces to fulfill all of the capabilities described in the JIC and NWP, and *they all need to be complementarily designed so that they work efficiently together*. As an example, if the desired air connector and surface connector are too big to fit in the hanger deck and well deck of the staging platform, measuring the number of CH-46 or LCAC equivalent spots provided by that staging platform is meaningless. Connector craft selected impacts the amount of fuel required to be supplied to the Seabase, and so on. Accounting for all of the interactions between various components is exceedingly complex, and cannot be usefully conducted until the potential solution set has been limited in scope to some extent. As various parts of the Seabasing concept come into clearer focus in the near



future, accounting for these interactions in the utility metrics will become a much more tractable problem.

Due to restraints of time and the limited availability of public domain information, some metrics were not considered in this analysis. One such improvement would be to include in the determination of the number of connectors required to support a MEB, a calculation based on capacity requirements for assault movement as opposed to using only sustainment requirements. Another valuable metric would be the ability of various connectors, particularly aircraft, to operate from the staging platforms in sea states up to four. A limitation to the cost analysis model used in this study is that it does not capture the research and development costs for a give technology or system. This is accounted for to some extent in the Developmental Status field, but a more accurate estimation of these costs would be valuable. A future extension of this method could improve in one or more of these areas.

A fully-developed Seabasing capability would be of substantial value to the Joint Force commander, enhancing the Joint Force's freedom of action and significantly improving its agility in support of national military and strategic objectives. Two main challenges must be faced prior to the full implementation of Seabasing, though. The first challenge is that fully implementing Seabasing as described in JIC/NWP would be very expensive. The projected MPF(F) squadron ships, not including the accompanying ESG, will cost about \$15 billion.<sup>150</sup> Alternative staging platforms may cost as much as \$23.8

---

<sup>150</sup> MPF(F) squadron total cost: 1x LHD (\$1,205 million) + 2x LHA(R) (\$2,806 million each) + 3x MLP (\$953.3 million each) + 3x T-AKR (\$1,024 million each) + 3x T-AKE (\$420.3 million each) + 2x Legacy T-AK (\$484.6 million each) = \$14,979 million, or about \$15 billion.

billion.<sup>151</sup> On top of this shipbuilding cost are the additional costs of surface and aircraft connectors.

The second challenge is that several critical pieces of the Seabasing system do not yet exist. For example, no air connector in sight fully meets Seabasing requirements and the physics and engineering problems of ship-to-ship transfer at high sea states still remain to be solved.

Taken together, these two problems mean that Seabasing implementation needs proceed cautiously to ensure that resources invested will yield the desired results. A wise strategy would include developing single prototype or surrogate platforms. These prototypes would be used for testing, experimentation and modification of the technologies, designs, procedures, and doctrines until all of the required component functions of Seabasing have been demonstrated in real-world conditions. Only then does it make sense to make the large investments required to fully realize Seabasing capabilities.

This study has demonstrated a method by which various solutions can be analytically compared through the lens of Seabasing requirements, factoring in other considerations, to assess their relative value. This method can easily be extended and adjusted to add, modify, or delete metrics by which value is measured and to adjust the relative weighting of value between the different areas measured. What specific metrics and weightings are appropriate may be debated, but the process of making a comparison like this is essential to ensure that scarce resources are being efficiently applied to the problem.

---

<sup>151</sup> Cost for five Sea Force ships.

THIS PAGE INTENTIONALLY LEFT BLANK

## Appendix 1 – Detailed Analysis Results

Staging Platforms	LHA	LHD	LHA(R)	LPD 4	LPD 17	LSD 41	LSD 49	MLP	T-AKR (LMSR)	T-AKE	Legacy T-AK	MPF-2010	Sea Force	Maersk S-Conversion	Goal
Cargo Score	156000	145000	125000	51000	35000	8970	67600	0	0	1108592	668160	1166400	960000	230400	560000
Vehicle	3	3	2	1	1	0	1	0	0	10	10	10	10	4	
Vehicle Score	28700	24012	12000	14000	25000	11831	20200	0	380000	0	162500	132000	69700	0	300000
Troops	1	1	0	0	1	0	1	0	10	0	5	4	2	0	
Troops Score	1902	2104	1102	885	667	504	508	900	0	0	100	3884	2000	6000	12700
Aircraft	1	2	1	1	1	0	0	1	0	0	0	3	2	5	
Aircraft Score	43	42	45	4	4	0	0	0	0	0	0	50	65	87	260
Surface	2	2	0	0	0	0	0	0	0	0	0	2	3	3	
Surface Score	1	3	0	1	2	4	2	6	0	0	0	2	3	1	31
Speed	0	1	0	0	1	1	1	2	0	0	0	1	1	0	
Speed Score	24	22	20	21	22	20	20	20	24	20	17.7	25	25	24.6	20
Seabasing Utility Score	4	4	4	4	4	4	4	4	4	4	3	4	4	4	
	11	13	9	6	8	5	7	7	14	14	18	24	22	16	
Homeland Defense and Civil Support	3	3	3	3	3	3	3	0	0	6	0	3	3	3	
Deterrence Operations	10	10	10	10	10	10	10	0	0	6	0	10	10	0	
Major Combat Operations	3	3	3	3	3	3	3	3	3	6	3	3	3	3	
Stability Operations	3	3	3	3	3	3	3	0	0	6	0	3	3	3	
Irregular Warfare	6	6	6	6	6	6	6	0	0	6	0	6	6	10	
Shaping Operations	3	3	3	3	3	3	3	0	0	6	0	3	3	0	
Joint Utility Score	28	28	28	28	28	28	28	3	3	36	3	28	28	19	
Development Status Score	50	50	30	50	50	50	50	30	50	50	50	10	10	30	
Cost per unit	764.6	1205.5	2806.2	1847.5	1423.9	765.5	527.6	953.3	1024	420.3	484.6	1031.8	3963	322.6	Million \$
Units to support MEB	1	2	2	1	1	1	1	3	3	3	2	5	6	3	
Cost per MEB	764.6	2411	5612.4	1847.5	1423.9	765.5	527.6	2859.9	3072	1260.9	969.2	5159	23778	967.8	Million \$
Cost Score	40	20	10	30	30	40	40	20	20	30	40	10	0	40	
Total Score	129	111	77	114	116	123	125	60	87	130	111	72	60	105	

<b>Aircraft Connectors</b>	CH-46	CH-53E	MV-22	CH-53K	Sikorsky X2HSL	V-44 QTR	Goal	
Cargo	4000	32000	17000	27000	40000	40000	40000	lbs
Cargo Score	1	8	4	7	10	10		
Speed	110	150	240	170	250	250	217	knots
Speed Score	5	7	10	8	10	10		
Range	75	50	200	110	250	500	200	nm
Range Score	4	3	10	6	10	10		
VTOL?	Y	Y	Y	Y	Y	Y		
VTOL Score	10	10	10	10	10	10		
Refuel?	Y	Y	Y	Y	N	Y		
Refuel Score	0	10	10	10	0	10		
<b>Seabasing Utility Score</b>	20	38	44	41	40	50		
Homeland Defense and Civil Support	3	6	6	6	6	6		
Deterrence Operations	3	6	6	6	6	6		
Major Combat Operations	3	6	6	6	6	6		
Stability Operations	3	6	6	6	6	6		
Irregular Warfare	3	6	6	6	6	6		
Shaping Operations	3	6	6	6	6	6		
<b>Joint Utility Score</b>	18	36	36	36	36	36		
<b>Development Status Score</b>	50	50	50	20	10	10		
Cost per unit	10.2	32	81.3	47.6	100	100		Million \$
Loads/day required	1189.0	148.6	279.8	176.1	118.9	118.9	118.9	
Time required/load	2.4	1.7	2.7	2.3	2.6	2.6	2.8	
Loads/day/aircraft	10.2	14.4	9.0	10.5	9.2	9.2	8.4	
Units to support MEB	147	13	39	22	17	17	18	
Cost per MEB	1499.4	416.0	3170.7	1047.2	1700.0	1700.0		Million \$
<b>Cost Score</b>	30	50	20	30	30	30		
<b>Total Score</b>	118	174	150	127	116	126		

<b>Surface Connectors</b>	LCAC	LCU	JMAC	LCU-X	LCTAC	Zubr	JHSV	Pelican WIG	Walrus	Goal	
Cargo	72	146	144	212	350	140	600	1400	500	140	tons
Cargo Score	5	10	10	10	10	10	10	10	10		
Speed	35	10	35	13	30	60	40	250	75	50	kts
Speed Score	7	2	7	3	6	10	8	10	10		
Range	46	600	100	600	1000	300	1200	10000	12000	150	nm
Range Score	3	10	7	10	10	10	10	10	10		
Amphibious Score	10	5	10	5	5	10	0	5	10		
<b>Seabasing Utility Score</b>	25	27	34	28	31	40	28	35	40		
Homeland Defense and Civil Support	0	3	0	3	0	0	6	6	6		
Deterrence Operations	0	0	0	0	0	0	0	6	6		
Major Combat Operations	6	3	6	3	6	3	6	6	6		
Stability Operations	0	3	0	3	0	0	6	6	6		
Irregular Warfare	0	3	0	3	0	0	6	6	6		
Shaping Operations	0	0	0	0	0	0	0	6	6		
<b>Joint Utility Score</b>	6	12	6	12	6	3	24	36	36		
<b>Development Status Score</b>	50	50	20	10	10	40	50	10	10		
Cost per unit	37	7.3	83.2	26.8	100	69.5	177	2263	905.2		Million \$
Units to support MEB	31	16	16	11	7	16	4	2	5	2232	tons of payload/MEB
Cost per MEB	1147	116.8	1331.2	294.8	700	1112	708	4526	4526		Million \$
<b>Cost Score</b>	30	50	30	50	40	30	40	10	10		
<b>Total Score</b>	111	139	90	100	87	113	142	91	96		

<b>At-Sea Cargo Transfer</b>	Internal	External	Direct	Goal	
Max Load	15	60	2.9	35	tons
Max Load Score	4	10	1		
Throughput	3	6	2.1	5	cont/hour
Throughput Score	6	10	4		
Max Sea State	3	2	5	4	
Max Sea State Score	8	5	10		
ISO-compatibility Score	5	10	0	5 pts for 20', 10 pts for 40'	
<b>Seabasing Utility Score</b>	23	35	15		
Homeland Defense and Civil Support	0	0	0		
Deterrence Operations	0	0	0		
Major Combat Operations	0	0	6		
Stability Operations	0	0	0		
Irregular Warfare	0	0	0		
Shaping Operations	0	0	0		
<b>Joint Utility Score</b>	0	0	6		
<b>Development Status Score</b>	40	20	20		
Cost per unit	12	138	10		Million \$
Units to support MEB	4	1	17		
Cost per MEB	48	138	170		Million \$
<b>Cost Score</b>	50	50	50		
<b>Total Score</b>	113	105	91		

<b>Logistics Support</b>	JMIDS	Automated Warehousing	
Selective Offload Score	10	10	
Modularity Score	10	10	
ITU-compatibility Score	10	5	
In-transit visibility Score	10	10	
<b>Seabasing Utility Score</b>	40	35	
Homeland Defense and Civil Support	6	6	
Deterrence Operations	6	6	
Major Combat Operations	6	6	
Stability Operations	6	6	
Irregular Warfare	6	6	
Shaping Operations	6	6	
<b>Joint Utility Score</b>	36	36	
<b>Development Status Score</b>	30	20	
Cost per unit	0.005	3.88889E-05	Million \$
Units to support MEB	32000	560000	
Cost per MEB	160	21.8	Million \$
<b>Cost Score</b>	50	50	
<b>Total Score</b>	156	141	

THIS PAGE INTENTIONALLY LEFT BLANK

## Appendix 2 – Calculation of Number of Aircraft Connectors Required

Calculation of the number of aircraft connectors required to support a MEB assumes that the requirements of supplying sustainment is the limiting case for cargo lift. 2,378 tons per day are required to support a brigade in sustained combat operations. This calculation assumes that sustainment operations are conducted twenty-four hours a day, thirty minutes each is required at both the staging platform and the destination for loading and unloading of the aircraft (total of one hour per cycle), and each aircraft will be available for missions eighty percent of the time. The following variables are used in this calculation:

$C_R$  = MEB daily sustainment cargo requirement (= 2,378 tons/day)

$C$  = Cargo capacity of aircraft connector (lbs)

$S$  = Speed of aircraft connector (knots)

$R$  = Operational radius (nm) – *This value is the lesser of 200 nm or the aircraft connector's maximum operational radius carrying the given cargo at the given speed*

$N$  = Number of aircraft connectors required

$$N = \frac{C_R \times (2000 \text{ lbs/ton}) \times [ 1 \text{ hr} + 2 \times (S \div R) ]}{C \times 80\% \times 24 \text{ hrs}}$$



THIS PAGE INTENTIONALLY LEFT BLANK

## Bibliography

- Bush, George W. *National Security Strategy of the United States of America*. Washington, D.C., 2006.
- Button, Robert, Irv Blickstein, John Gordon, Peter Wilson, and Jessie Riposo. *A Preliminary Investigation of Ship Acquisition Options for Joint Forcible Entry Operations*. Santa Monica, CA; RAND, 2005.
- Calvano, Charles N., Robert C. Harney, Fotis Papoulias, Robert Ashton, Dwight Warnock, Seth Miller, Lynn Fodrea, Matt Steeno, Luis Alvarez, Brian Higgins, Murat Korkut, Jihed Boulares, Mehmet Savur, Chong-ann The, Keng Shin Chong. *SEA FORCE: A Sea Basing Platform*. Monterey, CA: Naval Postgraduate School, Total Ship Systems Engineering Program, 2003.
- Calvano, Charles N., Robert C. Harney, Thomas Anderson, Jess Arrington, Joseph Kan, Garry McKerrow, Rajan Vaidyanathan, and Randolph R. Weekly. *The Maritime Prepositioning Force Ship 2010*. Monterey, CA: Naval Postgraduate School, Total Ships Systems Engineering Program, 1999.
- Carter, Worral R. *Beans, Bullets and Black Oil: The Story of Fleet Logistics Afloat in the Pacific during World War II*. Washington, D.C, 1953; reprint, Newport, RI: Naval War College Press, 1998.
- “CH-53K Super Stallion Heavy Lift Replacement.” Updated 30 September 2006, 16:01 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/aircraft/ch-53k.htm> on 4 March 2007.
- “CH-53X HLR & JHL: Future Heli Programs on Collision Course?” *Defense Industry Daily*, 27 September 2005. Accessed at <http://www.defenseindustrydaily.com/2005/09/ch53x-hlr-jhl-future-heli-programs-on-collision-course/index.php> on 4 March 2007.
- Cole, William. “The Pelican: A Big Bird for the Long Haul.” *Boeing Frontiers Online* 1, no. 5 (September 2002). Accessed at [http://www.boeing.com/news/frontiers/archive/2002/september/i\\_pw.html](http://www.boeing.com/news/frontiers/archive/2002/september/i_pw.html) on 4 March 2007.
- “CONREP Standard Tensioned Replenishment Alongside Method (STREAM).” Updated 19 July 2006, 17:21 UTC. In *Globalsecurity.org* Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/systems/unrep-stream.htm> on 6 March 2007.
- Gordon, John, IV, Peter A. Wilson, Jon Grossman, Dan Deamon, Mark Edwards, Darryl Lenhardt, Dan Norton, and William Sollfrey. *Assessment of Navy Heavy-Lift Aircraft Options*. Santa Monica, CA: RAND, 2005.

- Grossman, John, David Rubenson, William Sollfrey, and Brett Steele. *Vertical Envelopment and the Future Transport Rotorcraft: Operational Considerations for the Objective Force*. Santa Monica, CA: RAND, 2003.
- Hargrove Fires Up Gas Log Production with Automated Use-Point-Manager System. Dallas, TX: Cisco-Eagle Inc., 2007. Accessed at <http://www.cisco-eagle.com/CaseStudies/Printable/hargrove.pdf> on 6 March 2007.
- Hellberg, I. J. "Logistics for Commandos of the Royal Marines." in *The Falklands Conflict Twenty Years On: Lessons for the Future*, ed. Stephen Badsey, Rob Havers, and Mark Grove, 109-127. London: Frank Cass, 2005.
- "HSV 4676 WestPac Express." Updated 21 August 2005, 19:07 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/agency/navy/hsv-4676.htm> on 26 March 2007.
- Johnson, Mark E. "The Joint Modular Intermodal Container, is this the Future of Naval Logistics?" Master's thesis. Cambridge, MA: Massachusetts Institute of Technology, 2005.
- "Joint High Speed Vessel [JHSV]." Updated 7 July 2006, 22:24 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/jhsv.htm> on 26 March 2007.
- Jung, Alexander. "The Box That Makes the World Go Around." *Spiegel Online International*, 25 November 2005. Accessed at <http://www.spiegel.de/international/spiegel/0,1518,386799,00.html> on 26 February 2007.
- Kennedy, Stephen L. "An Analysis of Alternatives for Resupplying the Sea Base." Master's thesis, Monterey, CA: Naval Postgraduate School, 2002.
- Labs, Eric J., *The Future of the Navy's Amphibious and Maritime Prepositioning Forces*. Washington, D.C.: Congressional Budget Office, 2004.
- "Landing Craft, Air Cushion (LCAC)." Updated 17 July 2006, 21:57 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/lcac.htm> on 4 March 2007.
- "Largest Identified Transfers of Russian Arms in 2004." *Moscow Defense Brief* 1 (2005): 36.
- Leach, Henry. "Crisis Management and Task Force Assembly." in *The Falklands Conflict Twenty Years On: Lessons for the Future*, ed. Stephen Badsey, Rob Havers, and Mark Grove, 64-74. London: Frank Cass, 2005.

Liles, Christian F. M. and Christopher Bolkcom. *Military Helicopter Modernization: Background and Issues for Congress*. Washington, D.C.: Congressional Research Service, 2004.

“Logistics Over-the-Shore [LOTS].” Updated 17 July 2006, 21:57 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/lots.htm> on 6 March 2007.

*M1A2 Abrams: Main Battle Tank* brochure. Sterling Heights, MI: General Dynamics Land Systems, 2003. Accessed at <http://www.gdls.com/programs/m1a2.html> on 19 February 2007.

McNamara, Robert to Lyndon Johnson. “Defense Department Budget for FY 69.” Draft memorandum. 1 December 1967. U.S. Department of State, Office of the Historian, Foreign Relations, 1964-1968, Vol. X, National Security Policy, Document #195. Accessed at <http://www.state.gov/r/pa/ho/frus/johnsonlb/x/9100.htm> on 6 March 2007.

“Mobile Landing Platform [MLP] Pictures.” Updated 27 June 2006, 20:35 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/images/mlp-image02.jpg> on 25 February 2007.

*NAVSTORS Automated Stowage and Retrieval System*. Agile Systems Inc., 2005. Accessed at <http://www.agilesystems.com/navstors%20system.htm> on 6 March 2007.

“New Cranes a Christmas Present for Auckland.” *Ports of Auckland Newsroom*, 13 December 2006. Accessed at <http://www.poal.co.nz/newsroom/New%20Cranes%20061213.htm> on 6 March 2007.

Polmar, Norman. *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, 15th ed. Annapolis, MD: Naval Institute Press, 1993.

“Project 1232.2 Zubr Pomornik Class Amphibious Landing Craft Specifications.” Updated 22 April 2006, 22:17 UTC. In *Globalsecurity.org*. Database on-line. Accessed at [http://www.globalsecurity.org/military/world/russia/1232\\_2-specs.htm](http://www.globalsecurity.org/military/world/russia/1232_2-specs.htm) on 4 March 2007.

“Project 904/902R Orlan Class Amphibious Landing Craft.” Updated 22 April 2006, 22:16 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/world/russia/904.htm> on 4 March 2007.

“Quad Tilt-Rotor.” Updated 22 September 2005, 18:38 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/aircraft/qtr.htm> on 4 March 2007.

“Russian Shipbuilder to Sign Landing Craft Contract with China.” *News from Russia: Weekly News Bulletin Edited and Published by the Information Department of the Russian Embassy in India*, 8 September 2006, 13. Accessed at <http://www.india.mid.ru/nfr2006/nf31.html> on 7 March 2007.

*Sikorsky CH-53K Helicopter* brochure. Stratford, CT: Sikorsky, 2006.

“T-AKE Lewis and Clark Specifications.” Updated 6 October 2006, 21:41 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/ship/take-specs.htm> on 25 February 2007.

Thede, Peter J., Richard C. Staats, and William S. Crowder. *Assessment of the Heavy Lift Landing Craft, Air Cushioned*. McLean, VA: Logistics Management Institute, 1995.

U.S. Congress. House. Committee on Appropriations. Subcommittee on the Department of Defense. *Department of Defense Appropriations for 1990: Hearing before a Subcommittee of the Committee on Appropriations*. 101<sup>st</sup> Cong., 1<sup>st</sup> sess., 2 May 1989.

\_\_\_\_\_. *Department of Defense Appropriations for 1985: Hearing before a Subcommittee of the Committee on Appropriations*. 98<sup>th</sup> Cong., 2nd sess., 8 May 1984.

U.S. Department of Defense. *Program Acquisition Costs by Weapons System: Department of Defense Budget for Fiscal Year 2008*. Washington, D.C., 2007.

U.S. Department of Defense. Defense Advanced Research Projects Agency. *Walrus Global Reach Air Vehicle Design Program: Phase I Program Solicitation PS05-01*. Washington, D.C., 2005.

U.S. Department of Defense. Department of the Air Force. *Factsheets: C-5 Galaxy*. Washington, D.C., 2006. Accessed at <http://www.af.mil/factsheets/factsheet.asp?id=84> on 4 March 2007.

U.S. Department of Defense. Department of the Navy. *Fiscal Year (FY) 2006/FY 2007 Budget Estimates, Justification of Estimates: Shipbuilding and Conversion, Navy*. Washington, D.C., 2005.

\_\_\_\_\_. *Fiscal Year (FY) 2007 Budget Estimates Submission Justification of Estimates: Aircraft Procurement, Navy, Vol I: Budget Activities 1-4*. Washington, D.C., 2006.

\_\_\_\_\_. *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: National Defense Sealift Fund*. Washington, D.C., 2007.

- \_\_\_\_\_. *Fiscal Year (FY) 2008/2009 Biennial Budget Justification of Estimates: Shipbuilding and Conversion, Navy*. Washington, D.C., 2007.
- \_\_\_\_\_. *Lessons of the Falklands Summary Report February 1983*. Washington, D.C., 1983.
- \_\_\_\_\_. *US Navy Fact File: Amphibious Transport Dock – LPD*. Washington, D.C. 2006. Accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=600&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=600&ct=4) on 25 February 2007.
- \_\_\_\_\_. *US Navy Fact File: Dock Landing Ship – LSD*. Washington, D.C. 2006. Accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=1000&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1000&ct=4) on 25 February 2007.
- \_\_\_\_\_. *US Navy Fact File – Landing Craft, Air Cushion*. Washington, D.C., 2003. Accessed at [http://www.navy.mil/navydata/fact\\_display.asp?cid=4200&tid=1500&ct=4](http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1500&ct=4) on 4 March 2007.
- U.S. Department of Defense. Department of the Navy. Gordon R. England. *Naval Transformation Roadmap 2003*. Washington, D.C., 2003.
- U.S. Department of Defense. Marine Corps Combat Development Command. *Marine Corps Reference Publication (MCRP) 3-31B, Amphibious Ships and Landing Craft Data Book*. Washington D.C., 2001.
- U.S. Department of Defense. Marine Forces Pacific. *Marine Air-Ground Task Force Composition and Utilization*. Microsoft PowerPoint presentation. Aiea, HI, 2006.
- U.S. Department of Defense. Military Sealift Command. *Military Sealift Command – LMSR Fact Sheet*. Washington, D.C., 2007. Accessed at <http://www.msc.navy.mil/factsheet/lmsr.asp> on 25 February 2007.
- \_\_\_\_\_. *Military Sealift Command – T-AKE Fact Sheet*. Washington, D.C., 2007. Accessed at <http://www.msc.navy.mil/factsheet/t-ake.htm> on 25 February 2007.
- U.S. Department of Defense. Naval Center for Cost Analysis. *Inflation\_Calc\_FY08\_Ver\_1.xls*. Microsoft Excel worksheet. Washington, D.C., 2007. Accessed at <http://www.ncca.navy.mil/services/inflation.cfm> on 21 February 2007.
- U.S. Department of Defense. Naval Research Advisory Committee. *Sea Basing*. Washington, D.C., 2005.

- U.S. Department of Defense. Naval Surface Warfare Center. Littoral Warfare Systems Product Area Directorate. *Seabasing S&T And R&D: Roadmap for a Joint Capability*. Microsoft PowerPoint presentation. Washington, D.C., 2006.
- U.S. Department of Defense. Navy Warfare Development Command and Marine Corps Combat Development Command. *NWP 3-62M/MCWP 3-31.7 (AUGUST 2006), SEABASING*. Newport, RI, 2006.
- U.S. Department of Defense. Office of Naval Research. *Sea Base Transformational Package and Ordnance Rapid Transfer System (TransPORTS) Prototype Demonstrator Broad Agency Announcement*. Washington, D.C., 2005.
- U.S. Department of Defense. Office of the Chief of Naval Operations and Headquarters, U.S. Marine Corps, Michael G. Mullen and Michael W. Hagee. *Naval Operations Concept 2006*. Washington, D.C., 2006.
- U.S. Department of Defense. Office of the Chief of Naval Operations. N85. Force Application FCB Working Group. *Ship-to-Shore Connector (SSC) Initial Capabilities Document*. Microsoft PowerPoint presentation. Washington D.C., 2006. Accessed at <http://www.mfp.usmc.mil/TeamApp/G4Surface/Topics/20040923150704/FA%20FCB%20WG%20brief%206%20Jul%2006.ppt> on 9 February 2007.
- U.S. Department of Defense. Office of the Joint Chiefs of Staff, Richard B. Meyers. *The National Military Strategy of the United States of America*. Washington, D.C., 2004.
- U.S. Department of Defense. Office of the Joint Chiefs of Staff. *Seabasing Joint Integrating Concept: Version 1.0*. Washington D.C., 2005.
- \_\_\_\_\_. *Joint Pub 4-01.7: Tactics, Techniques, and Procedures for Use of Intermodal Containers in Joint Operations*. Washington D.C., 1997.
- U.S. Department of Defense. Office of the Joint Chiefs of Staff. J7 Joint Experimentation, Transformation and Concepts Division. *Joint Transformation and Concepts*. Microsoft PowerPoint presentation. Washington D.C., 2007. Accessed at <http://www.dtic.mil/futurejointwarfare/concepts/status.ppt> on 16 February 2007.
- U.S. Department of Defense. Office of the Secretary of Defense, Donald H. Rumsfeld. *National Defense Strategy of the United States of America*. Washington D.C., 2005.
- \_\_\_\_\_. *Quadrennial Defense Review Report*. Washington, D.C., 2006.
- U.S. Department of Defense. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, William Schneider, Jr., chairman. *Defense Science Board Task Force on SEA BASING*. Washington, D.C., 2003.

U.S. Department of Defense. U.S. Marine Corps. *HQMC Fact Files: CH-53E Super Stallion Helicopter*. Washington, D.C., 1995. Accessed at <http://www.hqmc.usmc.mil/factfile.nsf/7e931335d515626a8525628100676e0c/8a583a9bef2c6f8d8525626e0048f5fc?OpenDocument> on 4 March 2007.

U.S. General Accounting Office. *Historical Analysis of Navy Ship Leases*. Washington, D.C., 1999.

\_\_\_\_\_. *Improving Amphibious Capability Would Require Larger Share of Budget Than Previously Provided*. Washington, D.C., 1996.

\_\_\_\_\_. *Status of Major Acquisitions as of September 30, 1982*. Washington, D.C., 1983.

U.S. General Accounting Office. Comptroller General. *Report to the Congress on the 1978 Navy Shipbuilding Claims Settlement at Litton/Ingalls Shipbuilding—Status as of August 1, 1982*. Washington, D.C., 1982.

“V-22 Osprey Specifications.” Updated 8 February 2006, 18:33 UTC. In *Globalsecurity.org*. Database on-line. Accessed at <http://www.globalsecurity.org/military/systems/aircraft/v-22-specs.htm> on 4 March 2007.

White, Samuel D. “VMM-263 Ready to Write Next Chapter in Osprey Program.” *Marine Corps News*, 7 March 2006. Accessed at <http://www.marines.mil/marinelink/mcn2000.nsf/0/217128503734FF2B8525712A004D67BC?opendocument> on 4 March 2007.

*X2 Technology* brochure. Stratford, CT: Sikorsky, 2006.



THIS PAGE INTENTIONALLY LEFT BLANK

## Vita

Lieutenant Commander Lockett, a native of Banning, California, graduated with distinction from United States Naval Academy in 1994, earning a Bachelor of Science Degree in Naval Architecture. After commissioning, he attended the University of California, Berkeley, graduating with a Masters of Engineering Degree in Naval Architecture and Offshore Engineering in December 1995. Following this, he completed nuclear power training at Orlando, Florida and Charleston, South Carolina.

Lieutenant Commander Lockett's first shipboard assignment was USS *Jefferson City* (SSN 759) in San Diego, California, where he served as Electrical Assistant, Main Propulsion Assistant, Chemical and Radiological Controls Assistant and Strike Officer from May 1997 to April 2000. During his tour, *Jefferson City* completed two overseas deployments to the Western Pacific and Arabian Gulf.

Lieutenant Commander Lockett next reported to the United States Naval Academy in Annapolis, Maryland. There he completed the Leadership and Education Development Program in June 2001, earning a Masters of Science Degree in Leadership and Human Resource Development from the Naval Postgraduate School. He then served as a Company Officer as well as an instructor of both leadership and engineering at the Naval Academy from June 2001 to May 2003.

Following completion of Submarine Officer Advanced Course, Lieutenant Commander Lockett reported for duty as Engineer Officer onboard USS *Houston* (SSN 713) in October 2003. During his tenure, *Houston* completed an Engineered Refueling Overhaul at Puget Sound Naval Shipyard in Bremerton, Washington; conducted a trans-Pacific move to her new home port of Guam; and completed several operational deployments to various parts of the Western Pacific.

Lieutenant Commander Lockett arrived at the Joint Forces Staff College in July 2006, to join the third class of the Joint Advanced Warfighting School. Following completion of this degree program, he will return to the fleet as the Executive Officer of USS *Pennsylvania* (SSBN 735).

THIS PAGE INTENTIONALLY LEFT BLANK